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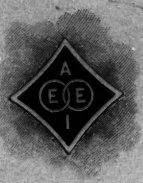

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THE

NATIONAL ELECTRICAL CODE,

AS ADOPTED BY THE

NATIONAL CONFERENCE ON STANDARD ELECTRICAL RULES.

New York, March 18th and 19th, 1896.

GENERAL PLAN

GOVERNING THE ARRANGEMENT OF RULES.

CLASS A.—**Central Stations, Dynamo, Motor and Storage-Battery Rooms, Transformer Sub-stations, etc.** Rules 1 to 11.

CLASS B.—**Outside Work,** all systems and voltages. Rules 12 and 13.

CLASS C.—**Inside Work.** Rules 14 to 39. Subdivided as follows:

General Rules, applying to all systems and voltages. Rules 14 to 17.

Constant-Current systems. Rules 18 to 20.

Constant-Potential systems.

All voltages. Rules 21 to 23.

Voltage not over 300. Rules 24 to 31.

Voltage between 300 and 3,000. Rules 32 to 37.

Voltage over 3,000. Rules 38 to 39.

CLASS D.—**Specifications for Wires and Fittings.** Rules 40 to 55.

CLASS E.—**Miscellaneous.** Rules 56 to 59.

CLASS F.—**Marine Wiring.** Rules 60 to 72.

GENERAL SUGGESTIONS.

In all electric work conductors, however well insulated, should always be treated as bare, to the end that under no conditions, existing or likely to exist, can a grounding or short circuit occur, and so that all leakage from conductor to conductor, or between conductor and ground, may be reduced to the minimum.

In all wiring special attention must be paid to the mechanical execution of the work. Careful and neat running, connecting, soldering, tapping of conductors and securing and attaching of fittings, are specially conducive to security and efficiency, and will be strongly insisted on.

In laying out an installation, except for constant-current systems, the work should, if possible, be started from a centre of distribution, and the switches and cut outs, controlling and connected with the several branches, be grouped together in a safe and easily accessible place, where they can be readily got at for attention or repairs. The load should be divided as evenly as possible among the branches, and all complicated and unnecessary wiring avoided.

The use of wire-ways for rendering concealed wiring permanently accessible is most heartily indorsed and recommended; and this method of accessible concealed construction is advised for general use.

Architects are urged, when drawing plans and specifications, to make provision for the channeling and pocketing of buildings for electric light or power wires, and in specifications for electric gas lighting to require a two-wire circuit, whether the building is to be wired for electric lighting or not, so that no part of the gas fixtures or gas piping be allowed to be used for the gas-lighting circuit.

CLASS A.

STATIONS AND DYNAMO ROOMS

Includes Central Stations, Dynamo, Motor and Storage Battery Rooms, Transformer Sub-Stations, Etc.

---

1. Generators.—

a. Must be located in a dry place.

b. Must never be placed in a room where any hazardous process is carried on, nor in places where they would be exposed to inflammable gases or flyings of combustible materials.

c. Must be insulated on floors or base frames, which must be kept filled to prevent absorption of moisture, and also kept clean and dry. Where frame insulation is impracticable, the inspection department having jurisdiction may, in writing, permit its omission, in which case the frame must be permanently and effectively grounded.

A high-potential machine which, on account of great weight or for other reasons, can not have its frame insulated from the ground, should be surrounded with an insulated platform. This may be made of wood, mounted on insulating supports, and so arranged that a man must always stand upon it in order to touch any part of the machine.

In case of a machine having an insulated frame, if there is trouble from static electricity due to belt friction, it should be overcome by placing near the belt a metallic comb connected with the earth, or by grounding the frame through a very high resistance of not less than 200 ohms per volt generated by the machine.

d. Every constant-potential generator must be protected from excessive current by a safety fuse, or equivalent device of approved design in each lead wire.

These devices should be placed on the machine or as near it as possible.

Where the needs of the service make these devices impracticable, the Inspection Department having jurisdiction may, in writing, modify the requirements.

e. Must each be provided with a waterproof cover.

f. Must each be provided with a name-plate, giving the maker's name, the capacity in volts and amperes, and normal speed in revolutions per minute.

2. Conductors.—

From generators to switchboards, rheostats or other instruments, and thence to outside lines.

a. Must be in plain sight or readily accessible.

b. Must have an *approved* insulating covering as called for by rules in Class "C" for similar work, except that in central stations, on exposed circuits, the wire which is used must have a heavy braided non-combustible outer covering.

Bus bars may be made of bare metal.

c. Must be kept so rigidly in place that they can not come in contact.

d. Must in all other respects be installed under the same precautions as required by rules in Class "C" for wires carrying a current of the same volume and potential.

3. Switchboards.—

a. Must be so placed as to reduce to a minimum the danger of communicating fire to adjacent combustible material.

Special attention is called to the fact that switchboards should not be built down to the floor, nor up to the ceiling, but a space of at least ten to twelve inches should be left between the floor and the board, and from eighteen to twenty-four inches between the ceiling and the board in order to prevent fire from communicating from the switchboard to the floor or ceiling, and also to prevent the forming of a partially concealed space very liable to be used for storage of rubbish and oily waste.

b. Must be made of non-combustible material or hardwood in skeleton form, filled to prevent absorption or moisture.

c. Must be accessible from all sides when the connections are on the back, but may be placed against a brick or stone wall when the wiring is entirely on the face.

d. Must be kept free from moisture.

e. Bus bars must be equipped in accordance with the rules for placing conductors.

4. Resistance Boxes and Equalizers.—

(*For construction rules, see No. 52.*)

a. Must be placed on a switchboard or, if not thereon, at a distance of a foot from combustible material, or separated therefrom by a non-inflammable, non-absorptive, insulating material.

5. Lightning Arresters.—

(*For construction rules, see No. 55.*)

a. Must be attached to each side of every overhead circuit connected with the station.

It is recommended to all electric light and power companies, that arresters be connected at intervals over systems in such numbers and so located as to prevent ordinary discharges entering (over the wires) buildings connected to the lines.

b. Must be located in readily accessible places away from combustible materials, and as near as practicable to the point where the wires enter the building.

Station arresters should generally be placed in plain sight on the switchboard.

In all cases, kinks, coils and sharp bends in the wires between the arresters and the out-door lines must be avoided as far as possible.

c. Must be connected with a thoroughly good and permanent ground connected by metallic strips or wires having a conductivity not less than that of a No. 6 B. & S. copper wire, which must be run as nearly in a straight line as possible from the arresters to the earth connection.

Ground wires for lighting arresters must not be attached to gas pipes within the buildings.

It is often desirable to introduce a choke coil in the circuit between the arresters and the dynamo. In no case should the ground wire from a lightning arrester be put into iron pipes, as these would tend to impede the discharge.

6. Care and Attendance.—

a. A competent man must be kept on duty where generators are operating.

b. Oily waste must be kept in *approved* metal cans and removed daily.

Approved waste cans shall be made of metal, with legs raising can three inches from the floor, with self-closing covers.

7. Testing of Insulation Resistance.—

a. All circuits must be provided with reliable ground detectors. Detectors which indicate continuously, and give an instant and permanent indication of a ground are preferable. Ground wires from detectors must not be attached to gas pipes within the building.

b. Where continuously indicating detectors are not feasible, the circuits should be tested at least once per day, and preferably oftener.

c. Data obtained from all tests must be preserved for examination by the Inspection Department having jurisdiction.

These rules on testing to be applied at such places as may be designated by the Inspection Department having jurisdiction.

8. Motors.—

a. Must be insulated on floors or base frames, which must be kept filled to prevent absorption of moisture; and must be kept clean and dry. Where frame insulation is impracticable, the Inspection Department having jurisdiction may, in writing, permit its omission, in which case the frame must be permanently and effectively grounded.

A high-potential machine which, on account of great weight or for other reasons, can not have its frame insulated, should be surrounded with an insulated platform. This may be made of wood, mounted on insulating supports, and so arranged that a man must stand upon it in order to touch any part of the machine.

In case of a machine having an insulated frame, if there is trouble from static electricity due to belt friction, it should be overcome by placing near the belt a metallic comb connected to the earth, or by grounding the frame through a very high resistance of not less than 200 ohms per volt generated by the machine.

b. Must be wired under the same precautions as required by rules in Class "C," for wires carrying a current of the same volume and potential.

The leads or branch circuits should be designed to carry a current at least fifty per cent. greater than that required by the rated capacity of the motor to provide for the inevitable overloading of the motor at times without over-fusing the wires.

c. The motor and resistance box must be protected by a cut out and controlled by a switch (see No. 17 *a*), said switch plainly indicating whether "on" or "off." Where one-quarter horse-power or less is used on low-tension circuits a single-pole switch will be accepted. The switch and rheostat must be located within sight of the motor, except in such cases where special permission to locate them elsewhere is given, in writing, by the Inspection Department having jurisdiction.

d. Must have their rheostats or starting boxes located so as to conform to the requirements of Rule 4.

In connection with motors the use of circuit breakers, automatic starting boxes and automatic under-load switches is recommeded, and they *must* be used when required.

e. Must not be run in series-multiple or multiple-series.

f. Must be covered with a water-proof cover when not in use, and, if deemed necessary by the Inspection Department having jurisdiction, must be inclosed in an approved case.

From the nature of the question the decision as to what is an approved case must be left to the Inspection Department having jurisdiction to determine in each instance.

g. Must, when combined with ceiling fans, be hung from insulated hooks, or else there must be an insulator interposed between the motor and its support.

h. Must each be provided with a name-plate, giving the maker's name, the capacity in volts and amperes and the normal speed in revolutions per minute.

9. Railway Power Plants.—

a. Must be equipped in each feed wire before they leave the station with an *approved* automatic circuit breaker (see No. 44) or other device, which will immediately cut off the current in case of a ground. This device must be mounted on a fireproof base, and in full view and reach of the attendant.

10. Storage or Primary Batteries.—

a. When current for light and power is taken from primary or secondary batteries, the same general regulations must be observed as applied to similar apparatus fed from dynamo generators developing the same difference of potential.

b. Storage battery rooms must be thoroughly ventilated.

c. Special attention is directed to the rules for rooms where acid fumes exist. (See No. 24, *j* and *k*.)

d. All secondary batteries must be mounted on non-absorptive, non-combustible insulators, such as glass, or thoroughly vitrified and glazed porcelain.

e. The use of any metal liable to corrosion, must be avoided in connections of secondary batteries.

11. Transformers.—

(*For construction rules see No. 54.*)

a. In central or sub-stations the transformers must be so placed that smoke from the burning out of the coils or the boiling over of the oil (where oil filled cases are used) could do no harm.

CLASS B.

OUTSIDE WORK.

All Systems and Voltages.

12. Wires.—

a. Service wires must have an *approved* rubber insulating covering. (See No. 40 *a.*) Line wires, other than services, must have an *approved* weather-proof, or rubber insulating covering. (See No. 40 *a* and *b.*) All the wires must have an insulation equal to that of the conductors they confine.

b. Must be so placed that moisture can not form a cross connection between them, not less than a foot apart, and not in contact with any substance other than their insulating supports. Service blocks must be covered over their entire surface with at least two coats of waterproof paint.

c. Must be at least seven feet above the highest point of flat roofs, and at least one foot above the ridge of pitched roofs over which they pass or to which they are attached.

d. Must be protected by dead insulated guard iron or wires from possibility of contact with other conducting wires or substances to which current may leak. Special precautions of this kind must be taken where sharp angles occur, or where any wires might possibly come in contact with electric light or power wires.

e. Must be provided with petticoat insulators of glass or porcelain. Porcelain knobs or cleats and rubber hooks will not be approved.

f. Must be so spliced or joined as to be both mechanically and electrically secure without solder. The joints must then be soldered, to insure preservation, and covered with an insulation equal to that on the conductors.

All joints must be soldered, even if made with some form of patent splicing device. This ruling applies to joints and splices in all classes of wiring covered by these rules.

g. Must, where they enter buildings, have drip loops outside, and the holes through which the conductors pass must be bushed with non-combustible, non-absorptive insulating tubes slanting upward toward the inside.

h. Telegraph telephone and similar wires must not be placed on the same cross-arm with electric light or power wires.

i. The metallic sheathes to cables must be permanently and effectively connected to "earth."

TROLLEY WIRES.

j. Must not be smaller than No. 0 B. & S. copper or No. 4 B. & S. silicon bronze, and must readily stand the strain put upon them when in use.

k. Must have a double insulation from the ground. In wooden pole construction, the pole will be considered as one insulation.

l. Must be capable of being disconnected at the power plant, or of being divided into sections, so that, in case of fire on the railway route, the current may be shut off from the particular section and not interfere with the work of the firemen. This rule also applies to feeders.

m. Must be safely protected against accidental contact where crossed by other conductors.

Guard wires should be insulated from the ground and should be electrically disconnected in sections of not more than 300 feet in length.

GROUND RETURN WIRES.

n. For the diminution of electrolytic corrosion of underground metal work, ground return wires must be so arranged that the difference of potental between the grounded dynamo terminal and any point on the return circuit will not exceed twenty five volts.

It is suggested that the positive pole of the dynamo be connected to the trolley line, and that whenever pipes or other underground metal work are found to be electrically positive to the rails or surrounding earth, that they be connected by conductors arranged so as to prevent as far as possible current flow from the pipes unto the ground.

13. Transformers.—

(*For construction rules, see No. 54.*)

a. Must not be placed inside of any building, excepting central stations, unless by special permission of the Inspection Department having jurisdiction.

b. Must not be attached to the outside walls of buildings unless separated therefrom by substantial supports.

CLASS C.

INSIDE WORK.

All Systems and Voltages.

GENERAL RULES—ALL SYSTEMS AND VOLTAGES.

14 Wires.—

(*For special rules, see Nos. 18, 24, 32, 38 and 39.*)

a. Must not be of smaller size than No. 14 B. & S., except as allowed under Rules 24*u* and 40*c*.

b. Tie wires must have an insulation equal to that of the conductors they confine.

c. Must be so spliced or joined as to be both mechanically and electrically secure without solder; they must then be soldered to insure preservation, and the joint covered with an insulation equal to that on the conductors.

Stranded wires must be soldered before being fastened under clamps or binding screws, and when they have a conductivity greater than No. 10 B. & S. copper wire, they must be soldered into lugs.

All joints must be soldered, even if made with some form of patent splicing device. This ruling applies to joints and splices in all classes of wiring covered by these rules.

d. Must be separated from contact with walls, floors timbers or partitions through which they may pass by non-combustible, non-absorptive insulating tubes, such as glass or porcelain.

Bushings must be long enough to bush the entire length of the hole in one continuous piece, or else the hole must first be bushed by a continuous waterproof tube, which may be a conductor, such as iron pipe; the tube then is to have a non-conducting bushing pushed in at each end so as to keep the wire absolutely out of contact with the conducting pipe.

e. Must be kept free from contact with gas, water or other metallic pipings, or any other conductors or conducting material which they may cross, by some continuous and firmly fixed non-conductor, creating a separation of at least one inch. Deviations from this rule may sometimes be allowed by special permission.

f. Must be so placed in wet places that an air space will be left between conductors and pipes in crossing, and the former must be run in such a way that they cannot come in contact with the pipe accidentally. Wires should be run over, rather than under, pipes upon which moisture is likely to gather or which, by leaking, might cause trouble on a circuit.

15. Underground Conductors.—

a. Must be protected, when brought into a building, against moisture and mechanical injury, and all combustible material must be kept removed from the immediate vicinity.

b. Must not be so arranged as to shunt the current through a building around any catch-box.

16. Table of Carrying Capacity of Wires.—

Below is a table showing the allowable carrying capacity of wires containing ninety-eight per cent. pure copper, which must be followed in placing interior conductors:

TABLE A.
Rubber Covered Wires.
See No. 40 *a*.

B. & S. G.	Amperes.
18	3
16	6
14	12
12	17
10	24
8	33
6	46
5	54
4	65
3	76
2	90
1	107
0	127
00	150
000	177
0000	210
Circular Mills.	
200,000	200
300,000	270
400,000	330
500,000	390
600,000	410
700,000	500
800,000	550
900,000	600
1,000,000	650
1,100,000	690
1,200,000	730
1,300,000	770
1,400,000	810
1,500,000	850
1,600,000	890
1,700,000	930
1,800,000	970
1,900,000	1,010
2,000,000	1,050

TABLE B.
Weatherproof Wires.
See No. 40 *b*.

Amperes.
5
8
16
23
32
46
65
77
92
110
131
156
185
220
262
312
300
400
500
590
680
760
840
920
1,000
1,080
1,150
1,220
1,290
1,360
1,430
1,490
1 550
1,610
1,670

The lower limit is specified for rubber-covered wires to prevent gradual deterioration of the high insulations by the heat of the wires, but not from fear of igniting the insulation. The question of drop is not taken into consideration in the above tables.

The carrying capacity of sixteen and eighteen wire is given, but no smaller than fourteen is to be used, except as allowed under Rules 24 *u* and 40 *c*.

17. Switches, Cut-outs, Circuit Breakers, Etc.—

(*For construction rules see Nos. 43, 44 and 45.*)

a. Must, whenever called for, unless otherwise provided (for exceptions see No. 8 *c* and No. 22 *c*), be so arranged that the cut-outs will protect, and the opening of the switch or circuit breaker will disconnect, all of the wires; that is, in a two-wire system the two wires, and in a three-wire system the three wires, must be protected by the cut-out and disconnected by the operation of the switch or circuit breaker.

b. Must not be placed in the immediate vicinity of easily ignitable stuff or where exposed to inflammable gases or dust or to flyings of combustible material.

c. Must, when exposed to dampness, either be inclosed in a waterproof box or mounted on porcelain knobs.

CONSTANT-CURRENT SYSTEMS.

Principally Series Arc Lighting.

18. Wires.—

(*See also Nos. 14, 15 and 16.*)

a. Must have an *approved* rubber insulating covering. (See No. 40 *a*.)

b. Must be arranged to enter and leave the building through an *approved* double-contact service switch (see No. 43), mounted in a non-combustible case, kept free from moisture, and easy of access to police or firemen. So-called "snap switches" must not be used on high-potential circuits.

c. Must always be in plain sight, and never incased, except when *required* by the Inspection Department having jurisdiction.

d. Must be supported on glass or porcelain insulators, which separate the wire at least one inch from the surface wired over, and must be kept *rigidly* at least eight inches from each other, except within the structure of lamps, on hanger-boards, in cut-out boxes, or like places, where a less distance is necessary.

e. Must on side walls, be protected from mechanical injury by a substantial boxing, retaining an air space of one inch around the conductors, closed at the top (the wires passing through bushed holes), and extending not less than seven feet from the floor. When crossing floor timbers in cellars or in rooms where they might be exposed to injury, wires must be attached by their insulating supports to the under side of a wooden strip not less than one-half an inch in thickness.

19. Arc Lamps.—

(*For construction rules, see No. 49.*)

a. Must be carefully isolated from inflammable material.

b. Must be provided at all times with a glass globe surrounding the arc, securely fastened upon a closed base. No broken or cracked globes to be used.

c. Must be provided with a wire netting (having a mesh not exceeding one and one-quarter inches) around the globe, and an *approved* spark arrester (see No. 50), when readily inflammable material is in the vicinity of the lamps, to prevent escape of sparks, melted copper or carbon. It is recommended that plain carbons, not copper-plated, be used for lamps in such places.

Arc lamps, when used in places where they are exposed to flyings of easily inflammable material, should have the carbons inclosed completely in a globe in such manner as to avoid the necessity for spark arresters.

For the present, globes and spark arresters will not be required on so-called "inverted arc" lamps, but this type of lamp must not be used where exposed to flyings of easily inflammable materials.

d. Where hanger boards (see No. 48) are not used, lamps must be hung from insulating supports other than their conductors.

20. Incandescent Lamps in Series Circuits.—

a. Must have the conductors installed as provided in Rule No. 18, and each lamp must be provided with an automatic cut-out.

b. Must have each lamp suspended from a hanger-board by means of a rigid tube.

c. No electro-magnetic device for switches and no system of multiple-series or series-multiple lighting will be approved.

d. Under no circumstances can they be attached to gas fixtures

CONSTANT-POTENTIAL SYSTEMS.

General Rules—All Voltages.

21. Automatic Cut-Outs (*Fuses and Circuit Breakers.*)

(*See No. 17, and for construction, Nos. 44 and 45.*)

a. Must be placed on all service wires, either overhead or underground, as near as possible to the point where they enter the building and inside the walls, and arranged to cut off the entire current from the building.

Where the switch required by Rule No. 22 is inside the building, the cut-out required by this section must be placed so as to protect it.

b. Must be placed at every point where a change is made in the size of wire [unless the cut-out in the larger wire will protect the smaller. (See No. 16)].

c. Must be in plain sight, or inclosed in an *approved* box (see No. 46), and readily accessible. They must not be placed in the canopies or shells of fixtures.

d. Must be so placed that no set of incandescent lamps, whether grouped on one fixture or several fixtures or pendants, requiring a current of more than six amperes shall be dependent upon one cut-out. Special permission may be given in writing by the Inspection Department having jurisdiction for departure from this rule in case of large chandeliers.

e. Must be provided with fuses the rated capacity of which does not exceed the allowable carrying capacity of the wire, and, when circuit breakers are used, they must not be set more than about thirty per cent above the allowable carrying capacity of the wire, unless a fusible cut-out is also installed in the circuit (see No. 16).

22. Switches.—

(*See No. 17, and for construction, No. 43.*)

a. Must be placed on all service wires, either overhead or underground, in a readily accessible place, as near as possible to the point where the wires enter the building, and arranged to cut off the entire current.

b. Must always be placed in dry, accessible places, and be grouped as far as possible. Knife switches must be so placed that gravity will tend to open rather than to close the switch.

c. Must not be single-pole, except when the circuits which they control supply not more than six 16 candle-power lamps or their equivalent.

d. Where gangs of flush switches are used, whether with conduit systems or not, the switches must be inclosed in boxes constructed of or lined with fire resisting material. Where two or more switches are placed under one plate, the box must have a separate compartment for each switch. No push buttons for bells, gas lighting circuits or the like shall be placed in the same wall plate with switches controlling electric light or power wiring.

23. Electric Heaters.—

a. Must, if stationary, be placed in a safe situation, isolated from inflammable materials and be treated as sources of heat.

b. Must each have a cut-out and *indicating* switch (see No. 17 *a*).

c. Must have the attachments of feed wires to the heaters in plain sight, easily accessible and protected from interference, accidental or otherwise.

d. The flexible conductors for portable apparatus, such as irons, etc., must have an *approved* insulating covering (see No. 40 *c*, 3).

e. Must each be provided with name plate, giving the maker's name and the normal capacity in volts and amperes.

LOW-POTENTIAL SYSTEMS.

300 Volts or Less.

Any circuit attached to any machine, or combination of machines, which develops a difference of potential, between any two wires, of over ten volts and less than 300 volts, shall be considered as a low-potential circuit, and as coming under the class, unless an approved transforming device is used, which cuts the difference of potential down to ten volts or less. The primary circuit not to exceed a potential of 3,000 volts.

24. Wires.—

General Rules.

(*See also Nos. 14, 15 and 16.*)

a. Must not be laid in plaster, cement or similar finish.

b. Must never be fastened with staples.

c. Must not be fished for any great distance, and only in places where the inspector can satisfy himself that the rules have been complied with.

d. Twin wires must never be used, except in conduits, or where flexible conductors are necessary.

e. Must be protected on side walls from mechanical injury. When crossing floor timbers in cellars or in rooms, where they might be exposed to injury, wires must be attached by their insulating supports to the under side of a wooden strip, not less than one-half inch in thickness, and not less than three inches in width.

Suitable protection on side walls may be secured by a substantial boxing, retaining an air space of one inch around the conductor, closed at the top (the wires passing through bushed holes), and extending not less than five feet from the floor; or by an iron-armored or metal-sheathed insulating conduit sufficiently strong to withstand the strain it will be subjected to; or plain metal pipe, lined with insulating tubing, which must extend one-half inch beyond the end of the metal tube.

The pipe must extend not less than five feet above the floor, and may extend through the floor in place of a floor bushing.

If iron pipes are used with alternating currents, the two or more wires of a circuit *must* be placed in the same conduit. In this case the insulation of each wire must be re-inforced by a tough conduit tubing projecting beyond the ends of the iron pipe at least two inches.

f. When run immediately under roofs, or in proximity to water tanks or pipes, will be considered as exposed to moisture.

SPECIAL RULES.

For Open Work (*In dry places*):

g. Must have an *approved* rubber or weatherproof insulation. (See No. 40 *a* and *b*.)

h. Must be rigidly supported on non-combustible, non-absorptive insulators, which separate the wire at least one-half inch from the surface wired over, and they must be kept apart at least two and one half inches.

Rigid supporting requires under ordinary conditions, where wiring along flat surfaces, supports at least every four and one-half feet. If the wires are liable to be disturbed, the distance between supports should be shortened. In buildings of mill construction, mains of No. 8 B. & S. wire or over, where not liable to be disturbed, may be separated about four inches, and run from timber to timber, not breaking around, and may be supported at each timber only.

This rule will not be interpreted to forbid the placing of neutral of a three-wire system in the centre of a three-wire cleat, provided the outside wires are separated two and one-half inches.

In damp places, such as Breweries, Packing Houses, Stables, Dye Houses, Paper or Pulp Mills, or buildings specially liable to moisture or acid or other fumes liable to injure the wires or their insulation, except where used for pendants.

i. Must have an *approved* rubber insulating covering (see No. 40 *a*).

j Must be rigidly supported on non-combustible, non-absorptive insulators which separate the wire at least one inch from the surface wired over, and they must be kept apart at least two and one-half inches.

Rigid supporting requires under ordinary conditions, where wiring over flat surfaces, supports at least every four and one-half feet. If the wires are liable to be disturbed, the distance between supports should be shortened. In buildings of mill construction, mains of No. 8 B. & S. wire or over, where not liable to be disturbed, may be separated about four inches and run from timber to timber, not breaking around, and may be supported at each timber only.

k. Must have no joints or splices.

For Molding Work:

l. Must have *approved* rubber insulating covering (see No. 40 *a*).

m. Must never be placed in moulding in concealed or damp places.

For Conduit Work:

n. Must have an *approved* rubber insulating covering (see No. 40 *c*).

The use of concentric wire (see No. 40 *c*) is recommended in preference to twin conductors.

o Must not be drawn in until all mechanical work on the building has been, as far as possible, completed.

p. Must not have wires of different circuits drawn in the same conduit.

q. Must, for alternating systems, have the two or more wires of a circuit drawn in the same conduit.

It is advised that this be done for direct-current system also, so that they may be changed to alternating systems at any time, induction troubles preventing such a change unless this construction is followed.

For so-called Concealed Work:

r. Must have an *approved* rubber insulating covering (see No. 40 *a*).

s. Must be rigidly supported on non-combustible, non-absorptive insulators which separate the wire at least one inch from the surface wired over, and must be kept at least ten inches apart, and, when possible, should be run singly on separate timbers or studding

Rigid supporting requires under ordinary conditions, where wiring along flat surfaces, supports at least every four and one-half feet. If the wires are liable to be disturbed, the distance between supports should be shortened.

t. When from the nature of the case it is impossible to place concealed wiring on non-combustible insulating supports of glass or porcelain, the wires if not exposed to moisture, may be fished on the loop system if incased throughout in approved continuous flexible tubing or conduit. (See page 45.)

For Fixture Work:

u. Must have an *approved* rubber insulating covering (see No. 40 *d*), and shall not be less in size than No. 18, B & S.

v. Supply conductors, and especially the splices to fixture wires, must be kept clear of the grounded part of gas pipes, and, where shells are used, the latter must be constructed in a manner affording sufficient area to allow this requirement.

w. Must, when fixtures are wired outside, be so secured as not to be cut or abraded by the pressure of the fastenings or motion of the fixture.

25. Interior Conduits.—

(*See also Nos. 24 n to q, and 41.*)

The object of a tube or conduit is to facilitate the insertion or extraction of the conductors to protect them from mechanical injury and as far as possible, from moisture. Tubes or conduits are to be considered merely as raceways, and are not to be relied upon for insulation between wire and wire, or between the wire and the ground.

a. Must be continuous from one junction box to another or to fixtures, and the conduit tube must properly enter all fittings.

b. Must be first installed as a complete conduit system, without the conductors.

c. Conduits must extend at least one-half inch beyond the finished surface of walls or ceilings, except that, if the end is threaded and a coupling screwed on, the conduit may be left flush with the surface, and the coupling may be removed when work on building is completed

d. Must, after conductors are introduced, have all outlets plugged with special wood or fibrous plugs, made in parts, and the outlet then sealed with *approved* compound. Joints must be made airtight and moisture proof.

e. Must have the metal of the conduit permanently and effectually grounded.

26. Fixtures.—

(*See also No. 24 u to w.*)

a. Must, when supported from the gas piping of a building, be insulated from the gas pipe system by means of *approved* insulating joints (see No. 51) placed as close as possible to the ceiling.

It is recommended that the gas outlet pipe be protected above the insulating joint by a non-combustible, non-absorptive insulating tube, having a flange at the lower end where it comes in contact with the insulating joint; and that, where outlet tubes are used, they be of sufficient length to extend below the insulating joint, and that they be so secured that they will not be pushed back when the canopy is put in place. Where iron ceilings are used, care must be taken to see that the canopy is thoroughly and permanently insulated from the ceiling.

b. Must have all burs, or fins, removed before the conductors are drawn into the fixture.

c. The tendency to condensation within the pipes should be guarded against by sealing the upper end of the fixture.

d. No combination fixture in which the conductors are concealed in a space less than one-fourth inch between the inside pipe and the outside casing will be approved.

e. Must be tested for "contacts" between conductors and fixtures, for "short circuits" and for ground connections before it is connected to its supply conductors.

f. Ceiling blocks of fixtures should be made of insulating material; if not, the wires in passing through the plate must be surrounded with non-combustible, non-absorptive, insulating material, such as glass or porcelain.

27. Sockets.—

(*For construction rules see No. 47.*)

a. In rooms where inflammable gases may exist, the incandescent lamp and socket must be inclosed in a vapor-tight globe, and supported on a pipe-hanger, wired with approved rubber-covered wire (see No. 40 *a*) soldered directly to the circuit.

b. In damp or wet places, or over specially inflammable stuff, waterproof sockets must be used.

When waterproof sockets are used, they should be hung by separate stranded rubber-covered wires, not smaller than No. 14 B. & S., which should preferably be twisted together when the drop is over three feet. These wires should be soldered direct to the circuit wires, but supported independently of them.

28. Flexible Cord.—

a. Must have an *approved* insulation and covering. (See No. 40 *c.*)

b. Must not be used as a support for clusters.

c. Must not be used except for pendants, wiring of fixtures and portable lamps or motors.

d. Must not be used in show windows.

e. Must be protected by insulating bushings where the cord enters the socket.

f. Must be so suspended that the entire weight of the socket and lamp will be borne by knots under the bushing in the socket, and above the point where the cord comes through the ceiling block or rosette, in order that the strain may be taken from the joints and binding screws.

29. Arc Lights on Low-Potential Circuits.—

a. Must have a cut-out (see No. 17 *a*) for each lamp or each series of lamps.

The branch conductors should have a carrying capacity about fifty per cent. in excess of the normal current required by the lamp to provide for heavy current required when lamp is started or when carbons become stuck without over-fusing the wires.

b. Must only be furnished with such resistances or regulators as are inclosed in non-combustible material, such resistances being treated as sources of heat. Incandescent lamps must not be used for resistance devices.

c. Must be supplied with globes and protected by spark arresters and wire netting around globe, as in the case of arc lights on high-potential circuits. (See Nos. 19 and 50.)

30. Economy Coils.—

a Economy and compensator coils for arc lamps must be mounted on non-combustible, non-absorptive insulating supports, such as glass or porcelain, allowing an air space of at least one inch between frame and support and in general to be treated like sources of heat.

31. Decorative Series Lamps.—

a Incandescent lamps run in series shall not be used for decorative purposes inside of buildings, except by special permission in writing from the Inspection Department having jurisdiction.

HIGH-POTENTIAL SYSTEMS.

300 TO 3,000 VOLTS.

Any circuit attached to any machine or combination of machines, which develops a difference of potential, between any two wires, of over 300 volts and less than 3,000 volts, shall be considered as a high potential circuit, and as coming under that class, unless an approved transforming device is used, which cuts the difference of potential down to 300 volts or less.

32. Wires.—

(*See also Nos. 14, 15 and 16.*)

a. Must have an *approved* rubber insulating covering. (See No. 40 *a.*)

b. Must be always in plain sight and never incased, except where required by the Inspection Department having jurisdiction.

c. Must be rigidly supported on glass or porcelain insulators, which raise the wire at least one inch from the surface wired over, and must be kept apart at least four inches for voltages up to 750 and at least eight inches for voltages over 750

Rigid supporting requires under ordinary conditions, where wiring along flat surfaces, supports at least about every four and one-half feet.

If the wires are unusually liable to be disturbed, the distance between supports should be shortened.

In buildings of mill construction, mains of No. 8 B. & S. wire or over, where not liable to be disturbed, may be separated about six inches for voltages up to 750 and about ten inches for voltages above 750; and run from timber to timber, not breaking around, and may be supported at each timber only.

d. Must be protected on side walls from mechanical injury by a substantial boxing, retaining an air space of one inch around the conductors, closed at the top (the wires passing through the bushed holes) and extending not less than seven feet from the floor. When crossing floor timbers, in cellars or in rooms, where they might be exposed to injury, wires must be attached by their insulating supports to the under side of a wooden strip not less than one-half an inch in thickness.

33. Transformers (*When permitted inside buildings, see No. 13*).—

(*For construction rules, see No. 54.*)

a. Must be located at a point as near as possible to that at which the primary wires enter the building.

b. Must be placed in an inclosure constructed of or lined with fire-resisting material; the inclosure to be used only for this purpose, and to be kept securely locked and access to the same allowed only to responsible persons.

c. Must be effectually insulated from the ground and the inclosure in which they are placed must be practically air tight, except that it shall be thoroughly ventilated to the outdoor air, if possible, through a chimney or flue. There should be at least six inches air space on all sides of the transformer.

34. Car Wiring.—

a. Must be always run out of reach of the passengers, and must have an *approved* rubber insulating covering. (See No. 40 *a.*)

35. Car Houses.—

a. Must have the trolley wires securely supported on insulating hangers.

b. Must have the trolley hangers placed at such a distance apart that, in case of a break in the trolley wire, contact can not be made with the floor.

c. Must have cut-out switch located at a proper place outside of the building, so that all trolley circuits in the building can be cut out at one point, and line circuit breakers must be installed, so that when this cut-out switch is open the trolley wire will be dead at all points within 100 feet of the building. The current must be cut out of the building wherever the same is not in use or the road not in operation.

d. Must have all lamps and stationary motors installed in such a way that one main switch can control the whole of each installation—lighting or

power—independently of main feeder-switch. No portable incandescent lamps or twin wire allowed, except that portable incandescent lamps may be used in the pits, connections to be made by two *approved* rubber-covered flexible wires (see No. 40 *a*), properly protected against mechanical injury; the circuit to be controlled by a switch placed outside of the pit.

e. Must have all wiring and apparatus installed in accordance with rules under Class "C" for constant potential systems.

f. Must not have any system of feeder distribution centering in the building.

g. Must have the rails bonded at each joint with not less than No. 2 B. & S. annealed copper wire; also a supplementary wire to be run for each track.

h Must not have cars left with trolley in electrical connection with the trolley wire.

36. Lighting and Power from Railway Wires.—

***a.* Must not be permitted, under any pretense, in the same circuit with trolley wires with a ground return, except in electric railway cars, electric car houses, and their power stations, nor shall the same dynamo be used for both purposes.**

37. Series Lamps.—

a. No system of multiple series or series-multiple for light or power will be approved.

b. Under no circumstances can lamps be attached to gas fixtures.

EXTRA HIGH-POTENTIAL SYSTEMS.

OVER 3,000 VOLTS.

Any circuit attached to any machine or combination of machines, which develops a difference of potential, between any two wires, of over 3,000 volts, shall be considered as an extra high potential circuit, and as coming under that class, unless an approved transforming device is used, which cuts the difference of potential down to 3,000 volts or less.

38. Primary Wires.—

Must not be brought into or over buildings, except power and sub-stations.

39. Secondary Wires.—

a, Must be installed under rules for high-potential systems, when their immediate primary wires carry a current at a potential of over 3,000 volts.

The high line insulation required for extra high-potential current tends to make the insulation resistance between primary and secondary coils of transformers a comparatively weak point, and lightning discharges would be apt to take this path to the earth. With the present means of protection against transformer break downs and the consequent liability of secondary wiring being subjected to the strain of the primary current, it is not deemed advisable to permit a primary current with a potential of over 3,000 volts without an intermediate step-down transformer. The presence of wires carrying a current at a potential of over 3,000 volts in the streets of cities and towns is also considered as increasing the fire hazard.

CLASS D.

FITTINGS, MATERIALS AND DETAILS OF CONSTRUCTION.

All Systems and Voltages.

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40. Wire Insulation.—

a. Rubber Covered.—The insulating covering must be solid, at least three sixty-fourths of an inch in thickness and covered with a substantial braid. It must not readily carry fire, must show an insulating resistance of one megohm per mile after two weeks' submersion in water at seventy degrees Fahrenheit and three days' submersion in lime water, and after three minutes' electrification with 550 volts. (See page 44.)

b. Weatherproof.—The insulating covering must not support combustion, must resist abrasion, must be at least one-sixteenth of an inch in thickness, and thoroughly impregnated with a moisture repellent

c. Flexible Cord.—Must be made of two stranded conductors, each having a carrying capacity equivalent to not less than a No. 16 B. & S. wire, and each covered by an *approved* insulation, and protected by a slow-burning, tough-braided outer covering.

1. Insulation for *pendants* under this rule must be moisture and flame proof.

2. Insulation for *cords used for all other purposes*, including portable lamps and motors, must be solid, at least one thirty-second of an inch in thickness, and must show an insulation resistance between conductors and between either conductor and the ground, at least one megohm per mile after one week's *submersion* in water at seventy degrees Fahrenheit, and after three minutes' electrification, with 550 volts.

3. The flexible conductors for *portable heating apparatus*, such as irons, etc., must have an insulation that will not be injured by the heat, such as asbestos, which must be protected from mechanical injury by an outer, substantial, braided covering and so arranged that mechanical strain will not be borne by the electrical connection.

d. Fixture Wire.—Must have a solid insulation, with a slow-burning, tough outer covering, the whole to be at least one thirty-second of an inch in thickness, and show an insulation resistance between conductors, and between either conductor and the ground, of at least one megohm per mile, after one week's submersion in water at seventy degrees Fahrenheit, and after three minutes' electrification, with 550 volts.

e. Conduit Wire.—Must comply with the following specifications:

1. *For insulated metal conduits* single wires and twin conductors must comply with Section *a*, of this rule.

Concentric wire must have a braided covering between the outer conductor and the insulation of the inner conductor, and, in addition, must comply with Section *a*, of this rule.

2. *For non-insulated metal conduits* single wires and twin conductors must comply with Section *a*, of this rule; and, in addition, have a second outer fibrous covering, at least one thirty-second of an inch in thickness, and sufficiently tenacious to withstand the abrasion of being hauled through the metal conduit

Concentric conductors must have a braided covering between the outer conductor and the insulation of the inner conductor, and comply with Section *a*, of this rule; and, in addition must have a second outer fibrous covering at least one thirty-second of an inch in thickness, and sufficiently tenacious to withstand the abrasion of being hauled through the metal conduit.

41. Interior Conduits.—

(*For wiring rules, see Nos. 24 and 25.*)

a. Each length of conduit, whether insulated or uninsulated, must have the maker's name or initials stamped in the metal or attached thereto in a satisfactory manner, so that the inspectors can readily see the same.

Insulated Metal Conduits:

b. The metal covering, or pipe, must be at least equal in thickness, or of equal strength to resist penetration by nails, etc., as the ordinary commercial form of gas pipe of same size.

c. Must not be seriously affected externally by burning out a wire inside the tube when the iron pipe is connected to one side of the circuit.

d. Must have the insulating lining firmly secured to the pipe.

e. The insulating lining must not crack or break when a length of the conduit is uniformly bent at a temperature of 212 degrees Fahrenheit to an angle of ninety degrees with a curve having a radius of fifteen inches, for pipes of one inch and less, and fifteen times the diameter of pipe for larger pipes.

f. The insulating lining must not soften injuriously at a temperature below 212 degrees Fahrenheit, and must leave water, in which it is boiled, practically neutral.

g. The insulating lining must be at least one thirty-second of an inch in thickness, and the materials of which it is composed must be of such a nature as will not have a deteriorating effect on the insulation of the conductor, and be sufficiently tough and tenacious to withstand the abrasion test of drawing in and out of the same long lengths of conductors.

h. The insulating lining must not be mechanically weak after three days' submersion in water, and, when removed from the pipe entire, must not absorb more than ten per cent. of its weight of water during 100 hours of submersion.

i. All elbows must be made for the purpose, and not bent from lengths of pipe. The radius of the curve of the inner edge of any elbow not to be less than three and one-half inches. Must have not more than the equivalent of four quarter bends from outlet to outlet, the bends at the outlets not being counted.

Uninsulated Metal Conduits:

j. Plain iron or steel pipes of equal thickness, or of equal strength, to resist penetration of nails, etc., as the ordinary commercial form of gas pipe of the same size, may be used as conduits, provided their interior surfaces are smooth and free from burs; pipe to be galvanized, or the interior surfaces coated or enameled, to prevent oxidization, with some substance which will not soften so as to become sticky and prevent wire from being withdrawn from the pipe.

k. All elbows must be made for the purpose, and not bent from lengths of pipe. The radius of the curve of the inner edge of any elbow not to be less than three and one-half inches. Must have not more than the equivalent of four quarter bends from outlet to outlet, the bends at the outlets not being counted.

42. Wooden Mouldings.—

(*For wiring rules see No. 24.*)

a. Must have, both outside and inside, at least two coats of waterproof paint, or be impregnated with a moisture repellent.

b. Must be made of two pieces, a backing and capping so constructed as to thoroughly incase the wire, and provide a one-half inch tongue between the conductors, and a solid backing, which, under grooves, shall not be less than three-eighths of an inch in thickness, and must afford suitable protection from abrasion.

It is recommended that only hardwood moulding be used.

43. Switches.—

(*See Nos. 17 and 22.*)

a. Must be mounted on non-combusiible, non-absorptive, insulating bases, such as slate or porcelain.

b. Must have carrying capacity sufficient to prevent undue heating.

c. Must, when used for service switches, indicate, on inspection, whether the current be "on" or "off."

d. Must be plainly marked whether it will always be visible, with the name of the maker and the current and voltage for which the switch is designed.

e. Must, for constant potential systems, operate successfully at fifty per cent. overload in amperes, with twenty-five per cent. excess voltage under the most severe conditions they are liable to meet with in practice.

f. Must, for constant potential systems, have a firm and secure contact; must make and break readily, and not stop when motion has once been imparted by the handle.

g. Must, for constant current systems, close the main circuit and disconnect the branch wires when turned "off"; must be so constructed that they shall be automatic in action, not stopping between points when started, and must prevent an arc between the points under all circumstances. They must indicate, upon inspection, whether the current be "on" or "off."

44. Cut-Outs and Circuit Breakers.—

(*For installation rules, see Nos. 17 and 21.*)

a. Must be supported on bases of non-combustible, non-absorptive insulating material.

b. Cut-outs must be provided with covers, when not arranged in approved cabinets, so as to obviate any danger of the melted fuse metal coming in contact with any substance which might be ignited thereby.

c. Cut-outs must operate successfully, under the most severe conditions they are liable to meet with in practice, on short circuits with fuses rated at 50 per cent. above and with a voltage 25 per cent. above the current and voltage for which they are designed.

d. Circuit-breakers must operate successfully, under the most severe conditions they are liable to meet with in practice, on short circuits when set at fifty per cent. above the current, and with a voltage twenty-five per cent. above that for which they are designed.

e. Must be plainly marked where it will always be visible, with the name of the maker, and current and voltage for which the device is designed.

45. Fuses.—

(*For installation rules, see Nos. 17 and 21.*)

a. Must have contact surfaces or tips of harder metal having perfect electrical connection with the fusible part of the strip.

b. Must be stamped with about eighty per cent. of the maximum current they can carry indefinitely, thus allowing about twenty-five per cent. overload before fuse melts.

With naked open fuses, of ordinary shapes and not over 500 amperes capacity, the *maximum* current which will melt them in about five minutes may be safely taken as the melting point, as the fuse practically reaches its maximum temperature in this time. With larger fuses a longer time is necessary.

Inclosed fuses where the fuse is often in contact with substances having good conductivity to heat, and often of considerable volume, require a much longer time to reach a maximum temperature on account of the surrounding material which heats up slowly.

This data is given to facilitate testing.

c. Fuse terminals must be stamped with the maker's name, initials, or some known trademark.

46. Cut-out Cabinets.—

a. Must be so constructed, and cut-outs so arranged, as to obviate any substance which might be ignited thereby.

A suitable box can be made of marble, slate or wood, strongly put together, the door to close against a rabbet so as to be perfectly dust tight, and it should be hung on strong hinges and held close by a strong hook or catch. If the box is wood, the inside should be lined with sheets of asbestos board about one-sixteenth of an inch in thickness, neatly put on and firmly secured in place by shellac and tacks. The wires should enter through holes bushed with porcelain bushings; the bushings tightly fitting the holes in the box, and the wires tightly fitting the bushings (using tape to build up the wire, if necessary) so as to keep out the dust.

47. Sockets.—

(*See No. 27.*)

a. No portion of the lamp socket, or lamp base, exposed to contact with outside objects, must be allowed to come into electrical contact with either conductor.

b. Must, when provided with keys, comply with the requirements for switches. (See No. 43.)

48. Hanger-Boards.—

a. Hanger-boards must be so constructed that all wires and current carrying devices thereon shall be exposed to view and thoroughly insulated by being mounted on a non-combustible, non-absorptive insulating substance. All switches attached to the same must be so constructed that they shall be automatic in their action, cutting off both poles to the lamp, not stopping between points when started and preventing an arc between points under all circumstances.

49. Arc Lamps.—

(*For installation rules, see No. 19.*)

a. Must be provided with reliable stops to prevent carbons from falling out in case the clamps become loose.

b. Must be carefully insulated from the circuit in all their exposed parts.

c. Must, for constant current systems, be provided with an *approved* hand switch, also an automatic switch that will shunt the current around the carbons, should they fail to feed properly.

The hand-switch to be approved, if placed anywhere except on the lamp itself, must comply with requirements for switches on hanger-boards as laid down in Rule 48.

50. Spark Arresters.—

(*See No. 19 c.*)

a. Spark arresters must so close the upper orifice of the globe that it will be impossible for any sparks, thrown off by the carbons, to escape.

51. Insulating Joints.—

(*See No. 26 a.*)

a. Must be entirely made of material that will resist the action of illuminating gases, and will not give way or soften under the heat of an ordinary gas flame, or leak under a moderate pressure. They shall be so arranged that a deposit of moisture will not destroy the insulating effect, and shall have an insulating resistance of at least 250,000 ohms between the gas-pipe attachments, and be sufficiently strong to resist the strain they will be liable to be subjected to in being installed.

b. Insulating joints having soft rubber in their construction will not be approved.

52. Resistance Boxes and Equalizers.—

(*For Installation rules, see No. 4.*)

a. Must be equipped with metal, or with other non-combustible frames.

The word "frame" in this section relates to the entire case and surroundings of the rheostat, and not alone to the upholding supports.

53. Reactive Coils and Condensers.—

a. Reactive coils must be made of non-combustible material, mounted on non-cumbustible bases and treated, in general, like sources of heat.

b. Condensers must be treated like apparatus operating with equivalent voltage and currents. They must have non-combustible cases and supports, and must be isolated from all combustible materials and, in general, treated like sources of heat.

54. Transformers.—

(*For installation rules, see Nos. 11 and 33.*)

a. Must not be placed in any but metallic or other non-combustible cases.

55. Lightning Arresters.—

(*For installation rules, see No. 5.*)

a. Must be mounted on non-combustible bases, and must be so constructed as not to maintain an arc after the discharge has passed, and must have no moving parts.

CLASS E.

MISCELLANEOUS.

56. Insulation Resistance.—

The wiring in any building must test free from grounds, *i. e.*, the complete installation between conductors and between all conductors and the ground (not including attachments, sockets, receptacles, etc.) of not less than the following:

Up to	5	amperes	4,000,000
"	10	"	2,000,000
"	25	"	800,000
"	50	"	400,000
"	100	"	200,000
"	200	"	100,000
"	400	"	50,000
"	800	"	25,000
"	1,600	"	12,500
		and over	

All cut-outs and safety devices in place in the above.

Where lamp sockets, receptacles and electroliers, etc., are connected, one-half of the above will be required.

57. Protection Against Foreign Currents.—

a. Where telephone, telegraph or other wires, connected with outside circuits, are bunched together within any building, or where inside wires are laid in conduits or ducts with electric light or power wires, the covering of such wires must be fire resisting, or else the wires must be inclosed in an air-tight tube or duct.

b. All aerial conductors and underground conductors, which are directly connected to aerial wires, connected with telephone, telegraph, district messenger, burglar alarm, watch-clock, electric-time and other similar instruments must be provided near the point of entrance to the building with some approved protective device which will operate to shunt the instruments in case of a dangerous rise of potential, and will open the circuit and arrest any abnormal current flow. Any conductor normally forming an innocuous circuit may become a source of fire hazard if crossed with another conductor charged with a relatively high pressure.

Protectors must have a non-combustible insulating base, and the cover to be provided with a lock similar to the lock now placed on telephone apparatus or some equally secure fastening, and to be installed under the following requirements:

1. The protector to be located at the point where the wires enter the building, either immediately inside or outside of the same. If outside, the protector to be enclosed in a metallic, waterproof case.

2. If the protector is placed inside of building, the wires of the circuit from the support outside to the binding posts of the protector to be of such insulation as is approved for service wires of electric light and power (See No. 40 *a*) and the holes through the outer wall to be protected by bushing the same as required for electric light and power service wires.

3. The wire from the point of entrance to the protector to be run in accordance with rules for high-potential wires, *i. e.*, free of contact with building and supported on non-combustible insulators.

4. The ground wire shall be insulated, not smaller than No. 16 B. & S. gauge copper wire. This ground wire shall be kept at least three inches from all conductors, and shall never be secured by uninsulated, double-pointed tacks, and must be run in as straight a line as possible to the ground connection.

5. The ground wire shall be attached to a water pipe, if possible, otherwise may be attached to a gas pipe. The ground wire shall be carried to, and attached to, the pipe outside of the first joint or coupling inside the foundation walls, and the connection shall be made by soldering, if possible. In the absence of other good ground, the ground shall be made by means of a metallic plate or a bunch of wires buried in a permanently moist earth.

58. Electric Gas Lighting.—

Where electric gas lighting is to be used on the same fixture with the electric light:

a. No part of the gas piping or fixture shall be in electric connection with the gas lighting circuit.

b. The wires used with the fixtures must have a non-inflammable insulation, or where concealed between the pipe and shell of the fixture, the insulation must be such as required for fixture wiring for the electric light.

c. The whole installation must test free from "grounds."

d. The two installations must test perfectly free from connection with each other.

59. Soldering Fluid.—

a. The following formula for soldering fluid is suggested:

Saturated solution of zinc chloride	5 parts.
Alcohol	4 parts.
Glycerine	1 part.

Class F.

MARINE WORK.

60. Generators.—

a. Must be located in a dry place.

b. Must have their frames insulated from their bed-plates.

c. Must each be provided with a waterproof cover.

d. Must each be provided with a name plate, giving the maker's name, the capacity in voltage and amperes and normal speed in revolutions per minute.

61. Wires.—

a. Must have an *approved* insulating covering.

The insulation for all conductors, except for portables, to be approved, must be at least one-eighth inch in thickness and be covered with a substantial waterproof and flame-proof braid. The physical characteristics shall not be affected by any change in temperature up to 200 degrees Fahrenheit. After two weeks' submersion in salt water at 70 degrees Fahrenheit it must show an insulation resistance of one megohm per mile after three minutes' electrification, with 550 volts.

b. Must have no single wire larger than No. 12 B. & S. Wires to be stranded when greater carrying capacity is required. No single solid wire smaller than No. 14 B. & S., except in fixture wiring, to be used.

Stranded wires must be soldered before being fastened under clamps or binding screws, and when they have a conductivity greater than No. 10 B. & S. copper wire, they must be soldered into lugs.

c. Must be supported in approved molding, except at switchboards and portables.

Special permission may be given for deviation from this rule in dynamo rooms.

d. Must be bushed with hard rubber tubing one-eighth inch in thickness when passing through beams and non-water-tight bulkheads.

e. Must have, when passing through water-tight bulkheads and through all decks, a metallic stuffing tube lined with hard rubber. In case of deck tubes, they shall be boxed near deck to prevent mechanical injury.

f. Splices or taps in conductors must be avoided as far as possible. Where it is necessary to make them, they must be so spliced or joined as to be both mechanically and electrically secure without solder. They must then be soldered, to insure preservation, covered with an insulating compound equal to the insulation of the wire, and further protected by a waterproof tape. The joint must then be coated or painted with a waterproof compound.

62. Portable Conductors.—

a. Must be made of two stranded conductors, each having a carrying capacity equivalent to not less than No. 14 B. & S. wire, and each covered with an approved insulation and covering.

Where not exposed to moisture or severe mechanical injury, each stranded conductor must have a solid insulation at least one-thirty-second of an inch in thickness, and must show an insulation resistance between conductors, and between either conductor and the ground, of at least one megohm per mile after one week's submersion in water at seventy degrees Fahrenheit and after three minutes' electrification, with 500 volts, and be protected by a slow-burning, tough-braided outer covering.

Where exposed to moisture and mechanical injury—as for use on decks, holds and fire rooms—each stranded conductor shall have a solid insulation, to be approved, of at least one-thirty-second of an inch in thickness and protected by a tough braid. The two conductors shall then be stranded together, using a jute filling. The whole shall then be covered with a layer of flax, either woven or braided, at least one-thirty-second of an inch in thickness, and treated with a non-inflammable, waterproof compound. After one week's submersion in water at seventy degrees Fahrenheit, with 550 volts and a three minutes' electrification, must show an insulation between the two conductors, or between either conductor and the ground of one megohm per mile.

63. Bell or other Wires.—

a. Shall never be run in same duct with lighting or power wires.

64. Table of Capacity of Wires.—

B. & S. G.	Area Actual C. M.	No. of Strands.	Size of Strands B. & S. G.	Amperes.
19	1,288	—	—	—
18	1,624	—	—	3
17	2,048	—	—	—
16	2,583	—	—	6
15	3,257	—	—	—
14	4,107	—	—	12
12	6,530	—	—	17
—	9,016	7	19	21
—	11,368	7	18	25
—	14,336	7	17	30
—	18,081	7	16	35
—	22,709	7	15	40
—	30,856	19	18	50
—	38,912	19	17	60
—	49,077	19	16	70
—	60,088	37	18	85
—	75 776	37	17	100
—	99,064	61	18	120
—	124,928	61	17	145
—	157,563	61	16	170
—	198,677	61	15	200
—	250,127	61	14	235
—	296,387	91	15	270
—	373,737	91	14	320
—	413,039	127	15	340

When greater conducting area than that of 12 B. & S. G. is required, the conductor shall be stranded in a series of 7, 19, 37, 61, 91 or 127 wires, as may be required; the strand consisting of one central wire, the remainder laid around it concentrically, each layer to be twisted in the opposite direction from the preceding.

65. Switchboards.—

a. Must be made of non-combustible, non-absorptive, insulating material, such as marble or slate.

b. Must be kept free from moisture, and must be located so as to be accessible from all sides.

c. Must have a main switch, main cut-out and ammeter for each generator.

Must also have a voltmeter and ground detector.

d. Must have a cut-out and switch for each side of each circuit leading from board.

66. Resistance Boxes.—

a. Must be made of non-combustible material.

b. Must be located on a switchboard or away from combustible material. When not placed on switchboard they must be mounted on non-inflammable, non-absorbtive insulating material.

c. Must be so constructed as to allow sufficient ventilation for the uses to which they are put.

67. Switches.—

a. Must have non-combustible, non-absorptive, insulating bases.

b. Must operate successfully at fifty per cent. overload in amperes with twenty-five per-cent. excess voltage under the most severe conditions they are liable to meet with in practice, and must be plainly marked where it will always be visible, with the name of the maker and the current and voltage for which the switch is designed.

c. Must be double-pole when circuits which they control supply more than six 16-candle-power lamps or their equivalent.

d. When exposed to dampness, they must be enclosed in a water-tight case.

68. Cut-outs.—

a. Must have non-combustible, non-absorptive, insulating bases.

b. Must operate successfully under the most severe conditions they are liable to meet with in practice, on short circuit with fuse rated at fifty per cent. above, and with a voltage twenty-five per cent. above the current and voltage they are designed for, and must be plainly marked where they will always be visible with the name of the maker and current and voltage for which the device is designed.

c. Must be placed at every point where a change is made in the size of the wire (unless the cut-out in the larger wire will protect the smaller).

d. In places such as upper decks, holds, cargo spaces and fire rooms, a water-tight and fireproof cut-out may be used, connecting directly to mains when such cut-out supplies not more than six 16-candle power lamps or their equivalent.

e. When placed anywhere except on switchboards and certain places, as cargo spaces, holds, fire-rooms, etc., where it is impossible to run from centre of distribution, they shall be in a cabinet lined with fire-resisting material.

f. Except for motors, search-lights and diving lamps shall be so placed that no group of lamps, requiring a current of more than six amperes, shall ultimately be dependent upon one cut-out.

A single-pole covered cut-out may be placed in the moulding when same contains conductors supplying current for not more than two 16-candle-power lamps or their equivalent.

69. Fixtures.—

a. Shall be mounted on blocks made from well seasoned lumber treated with two coats of white lead or shellac.

b. Where exposed to dampness, the lamp must be surrounded by a vapor-proof globe.

c. Where exposed to mechanical injury, the lamp must be surrounded by a globe protected by a stout wire guard.

d. Shall be wired with same grade of insulation as portable conductors which are not exposed to moisture or mechanical injury.

70. Sockets.—

a. No portion of the lamp socket or lamp base exposed to contact with outside objects shall be allowed to come into electrical contact with either of the conductors.

71. Wooden Mouldings.—

a. Must be made of well seasoned lumber, and be treated inside and out with at least two coats of white lead or shellac.

b. Must be made of two pieces, a backing and a capping, so constructed as to thoroughly incase the wire and provide a one-half-inch tongue between the conductors, and a solid backing which, under grooves, shall not be less than three-eighths inch in thickness.

c. Where moulding is run over rivets, beams, etc., a backing strip must first be put up and the moulding secured to this.

d. Capping must be secured by brass screws.

72. Motors.—

a. Must be wired under the same precautions as with a current of same volume and potential for lighting. The motor and resistance box must be protected by a double-pole cut-out and controlled by a double-pole switch, except in cases where one-quarter horse-power or less is used.

The leads or branch circuits should be designed to carry a current at least fifty per cent. greater than that required by the rated capacity of the motor to provide for the inevitable overloading of the motor at times.

b. Must be thoroughly insulated. Where possible, should be set on base frames made from filled, hard, dry wood and raised above surrounding deck. On hoists and winches they shall be insulated from bed-plates by hard rubber, fiber or similar insulating material.

c. Shall be covered with a waterproof cover when not in use.

d. Must each be provided with a name plate giving maker's name, the capacity in volts and amperes and the normal speed in revolutions per minute.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

NEW YORK, September 29th, 1897.

The 118th meeting of the INSTITUTE was held this date, at 12 West 31st Street, and was called to order by President Crocker at 8.20 P. M.

THE SECRETARY:—At the meeting of the Executive Committee of the Council, on September 15th, the following associate members were elected:

Name.	Address.	Endorsed by.
BLACK, HOWARD D.	Salesman, Blackall & Baldwin, 7 West 19th St.; P. O. Box 267 New York, N. Y.	S. S. Wheeler. F. B. Crocker. Gano S. Dunn.
BLACKALL, FREDERICK,	S. Selling Agent, Crocker-Wheeler Electric Co., P. O. Box 267 New York; residence, Roselle, N. J.	S. S. Wheeler Gano S. Dunn. F. B. Crocker.
GRAVES, CHAS. B.	Senior Student, Tufts College, Mass.; residence, Marblehead, Mass.	J. R. Lovejoy. Sidney B. Paine. C. D. Haskins.
STOUT, GEORGE H.	Representative of Crocker-Wheeler Electric Co. and Walker Co., Box 73 Atlantic Highlands, N.J.	C. S. Bradley. T. J. Smith. S. S. Wheeler.

Total 4.

THE PRESIDENT:—Gentlemen, as I appear here rather as an advocate than as a judge, it is proper that I should not preside at this meeting. It may be necessary for me to take part in the debate. My connection with this National Conference on Standard Electrical Rules ante-dated by more than a year my election to the presidency, and it was not practicable to sever that connection—certainly not before this meeting. Therefore I shall call upon Mr. Lieb, one of our Managers, to kindly take the chair.

Mr. Lieb then took the chair.

THE CHAIRMAN:—We will begin the presentation of the matter that is to come before the meeting this evening by the reading of Dr. Crocker's report.

The Secretary read the following:

American Institute of Electrical Engineers.

REPORT ON THE

"NATIONAL ELECTRICAL CODE."

The National Conference on Standard Electrical Rules met in New York City on March 18th and 19th, 1896. This body was composed of delegates representing the various Electrical, Insurance, Architectural and allied interests, and had for its object the adoption of one Electrical Code to take the place of the many conflicting Codes then in existence. Representatives of the principal electrical companies were invited to attend the Conference but it was decided at the meeting that these delegates should be made Associate Members and that the voting membership should be confined to the following Associations:

American Institute of Architects.
American Institute of Electrical Engineers.
American Society of Mechanical Engineers.
American Street Railway Association.
Factory Mutual Fire Insurance Companies.
National Association of Fire Engineers.
National Board of Fire Underwriters.
National Electric Light Association.
Underwriters' National Electric Association.

As a result of the labors of this Conference, acting in co-operation with the Underwriters' National Electric Association, a revised set of rules has been formulated to which the name "National Electrical Code" has been given, a copy of which is submitted herewith. This Code has already been adopted or approved by the following bodies:

Factory Mutual Fire Insurance Companies.
National Board of Fire Underwriters.
National Electric Light Association.
Underwriters' National Electric Association.
National Association of Fire Engineers.

The influence already exerted by the Institute in this matter has been most important; in fact, it is no exaggeration to say that the Conference would have failed to accomplish its object had the Institute held aloof from it. The representative of the Institute was appointed Chairman of the Committee on Code, which performed the actual work of revising the Rules. The New Code contains many amendments in regard to the technical requirements, and in form it has been entirely revised. The latter fact is particularly important, as previous codes had become a patch-work containing many repetitions and interpolations. This result alone is a sufficient reward for the labors of the Conference. It is not claimed that the Code is perfect, but it can be said that each word in it was carefully considered by a number of men representing the most diverse interests and points of view. If amendments are required in the future they can easily be made, the new arrangement of the Code being specially designed to enable this to be done without injury to its general form. In view of the very great advantages to be obtained by the general adoption of one

uniform Code for the whole country; the fact that it has already been adopted by the most important bodies represented in the Conference, and in order to complete the powerful and beneficial influence which the INSTITUTE has already exerted in this matter, your delegate earnestly recommends that the INSTITUTE give its approval to the "National Electrical Code." This action need not be an adoption of the Code which would be in any way binding upon the individual members of the INSTITUTE. All that is necessary is that the INSTITUTE should approve the Code as representing uniformity and co-operative action. One of the most important functions that the INSTITUTE can possibly perform is the encouragement and securing of the very uniformity which this Code so well represents.

Respectfully submitted,

FRANCIS B. CROCKER,

NEW YORK, Sept. 15th, 1897. *Delegate.*

THE CHAIRMAN:—Gentlemen, you have heard the report read by the Secretary in which this new code is submitted for your consideration, and I will now declare the discussion open. I think it might be well, and also as a recognition of the labors which he has bestowed on this subject, to ask Mr. William J. Hammer if he will kindly open the discussion.

MR. HAMMER:—I would rather have kept quiet just now and listened to others. I would like to say however, that when Dr. Crocker prepared his report as delegate from the INSTITUTE, there were only four names which appeared of associations which had already considered and adopted the National Electrical Code, and at that time I sent a letter to the official delegates of the other five associations to find out what action if any their associations had taken, and how soon they proposed to take action, in order that I might, perhaps, refer to it here. I at once heard from Captain Brophy that his association, that is the National Association of Fire Engineers, had unanimously adopted the code, and the notice was received in time to add it to the other four associations which had already adopted the code. I have this evening received a letter from the representative of the American Institute of Architects, whom I had seen personally and who assured me that the matter would come before the Executive Committee of his association, and he gave most positive assurance of its adoption by the American Institute of Architects. His letter, which I received this evening, says:

"Your favor of the 23d received and contents noted. We did not succeed in getting a quorum to attend the last Executive Committee meeting of the American Institute of Architects; but our annual convention is to be held in Detroit next week, preceded by the Board of Directors, at which time action will be taken upon the National Code. I have written a report to the convention, and also to the Directors on the subject which I shall present at the meeting.

Yours very truly,

Alfred Stone."

And I might say that I also received this afternoon a letter of similar import from Mr. Frank R. Ford, delegate of the Ameri-

can Street Railway Association, who is entirely in sympathy with this matter, and who has prepared his report for submission at the meeting of the American Street Railway Association in October, and from what we hear, there is every reason to expect that that association will adopt the National Electrical Code. We have also received a very strong assurance from the association under whose roof we are now assembled and who courteously extended the facilities of their house as the official headquarters of the National Conference on Standard Electrical Rules. It was here that we held our meeting and had our discussions. It was here that the Code Committee met, and we as an association have received very great courtesies from the American Society of Mechanical Engineers, and from what I personally have heard and from what Dr. Crocker tells me, there is practically no question but that that association will approve the National Electrical Code.

THE CHAIRMAN:—We would be glad to hear from Mr. Sachs, who, I understand, is prepared to discuss the subject under consideration.

MR. JOSEPH SACHS:—I did not come prepared to open the discussion upon this subject. Those who were more intimately connected with the formulation of the code might more properly begin. I would like to come in at the end. There are various sections of this new code which admit of discussion. The effect of various changes that have been made in the new, as distinguished from the old code, might be discussed and some of the new features criticised, others perhaps lauded. Amongst the novelties, for instance, in this new code, is the permission given to use plain pipe and the recommendation, if it may be so called, of automatic electro-magnetic circuit-breaking devices. These features stand out very distinctly, although there are also quite a number of others.

DR. A. E. KENNELLY:—I think that the INSTITUTE is to be congratulated upon the report that has been presented to it this evening and upon the National Electric Code as it appears before us in print. We all know how much confusion has existed in the past from the co-existence of a variety of different rules not merely in different parts of the country, but in different organizations of the same city. I cannot help thinking that the fusion of all pre-existing codes into a single code, if we can secure it, is so highly desirable, that we should do all in our power to bring it about. No doubt many of us may have our own ideas as to possible improvements in this code, but it seems to me that the advantage of national uniformity outweighs any objections that can be urged against any particular rules. I may be permitted to say that at the time when the INSTITUTE was invited to enter this National Conference, I had fears that such a conference might bring the INSTITUTE into unpleasant relations with commercial associations, and that bad feeling and dissension in the

INSTITUTE might ensue. I am glad to find that my fears have apparently been groundless, owing in large measure no doubt to tact and care of the officer delegated to represent the INSTITUTE at the Conference, and I think we may be gratified by the results which seems to have been reached, namely the agreement of so many conflicting interests and so much vested and uninvested capital upon a single set of rules. I would move sir, that the report here presented be adopted by the INSTITUTE, be spread upon the minutes, and that the National Electrical Code as it is here presented in pamphlet form, be printed in the TRANSACTIONS.

MR. GANO S. DUNN:—Mr. Chairman—I rise to second the motion most heartily. As Dr. Kennelly has said, there are a number of things in the code which do not agree with the ideas of all of us. Being connected with the manufacture of electrical machinery, there are several items that I would change, but, for the same reason, I appreciate the value of the code because of its uniformity, and I cannot fully express how much I feel that it is desirable for this INSTITUTE to approve this code and thereby assist in supporting it.

THE CHAIRMAN:—Gentlemen, you have heard the motion made by Dr. Kennelly that the report of Dr. Crocker be received, and the code accompanying it be spread upon the minutes and receive the formal approval of the INSTITUTE, and you have also heard the seconding of that motion by Mr. Gano S. Dunn. We will continue the discussion, if it is your pleasure, before the motion is put to a formal vote.

MR. C. O. MAILLOUX:—I note that in the latter portion of Dr. Crocker's report he says that "This action need not be an adoption of the code which would be in any manner binding upon the individual members of the INSTITUTE. All that is necessary is that the INSTITUTE should approve the code as representing uniformity and co-operative action." Now, gentlemen, I think that that is a very sensible way to put it, and I think that all our action in this matter ought to be bounded and limited by these two sentences. That is all that the report asks, and I think that is all that we should give to it. It asks merely that the code be approved as an evidence and a step of progress in the direction of uniformity and co-operative action. In adopting it in that way and in that form we are not committing the INSTITUTE or its members to any tacit approval of any of its contents, excepting in-so-far as the said contents may recommend themselves to individual judgment, and may accord with personal experience as to the requirements which the particular individual in question may possess. I regret that I have not been able to study carefully the rules. I have just lately returned from abroad and I found naturally a great deal to do, and two new sets of rules, on my hands, one issued by the City Fire Department and the new one by the National Board of Fire Underwriters. I have looked into the two sets only in-so-far as it has been necessary for me to do so to

guide me in carrying out the work which I have had in hand. Consequently, I cannot say that I have intimate enongh knowledge of the two sets of rules to be able to speak very exhaustively or to make any exhaustive commentary or criticism on either of them. I have been struck however with the thoroughness with which the City Fire Department rules have been worked up. I could not help noticing that they had gone into a good many points which are still left obscure in the other rules, and that they rationalized certain points which had been always treated in a somewhat arbitrary and empirical manner in all previous rules. I may note, for instance, the fact of making the insulation resistance required, a function of the working pressure. I may also note the fact that the separation between conductors or their distance apart, is made in the city rules, a function of the pressure or potential to be carried by the wires, as it ought to be. This I understand from conversing with the parties who have prepared these excellent rules. These rules have been made not perhaps on a strictly scientific basis, but, as a means of reconciling in a fashion that at least accords with the facts of experience and those of accepted practice, so as to produce rules which will not interfere too much with what has been done in the past, and at the same time will form a good guidance for what is to come in the future. Now, while I think that several of the excellent features in these City Fire Department rules, may apply more strictly to the work that is done in and about New York City, yet I also think that a complete, comprehensive code, such as a national code ought to be, should pay some deference to the good features of those rules. There are some points there which are very carefully discussed, more especially for instance, in relation to cut-outs, whether they be electro-magnetic or panel cut-outs or ordinary porcelain base fuse cut-outs, the subject being treated in a very logical, clear manner. There is also this very question of dynamo and motor installation which Mr. Sachs referred to. I find quite a variation between the two sets of rules. In New York City, for instance we are placed in the predicament of one rule asking us to insulate a dynamo and another rule asking us to ground it. and it would evidently be a difficult matter in a case of that kind to do what both ask. I remember once being asked under the old rules, in connection with a very large building not far from where we are now, to run wires in moulding with the capping left out. The next day another inspector came, and insisted, under the same rules that we must have it on. Of course I could not do it both ways. Finally, I had to have a conference at which something like ten different inspection authorities were present, and at which it was finally decided after several sessions, to do this and also other details in a certain manner, which by the way, did not particularly follow the rules. Now, in relation to the installation of dynamos, to take that point alone, (since I have not sufficient familiarity with the rules, as I have said to go into it more deeply), it

seems to me that some reference might have been made to the particular kind of dynamos—whether they be for high electrical pressure or low electrical pressure, whether they be intended for central stations or for isolated plants. I think it makes a great deal of difference. With the present direct-connected dynamos it is a physical impossibility to insulate without detriment to mechanical integrity and stability and it is also more or less, in many cases an impossibility to provide an insulated platform around them. So what is one going to do? One set of rules suggests that we had better ground them. I incline to the opinion that this set of rules may be about right, for an isolated plant and for low potentials, though the circumstances may be quite different in a central station and for high potentials. I think that in a central station, it might be desirable, especially with higher potentials, to insulate them under all circumstances, merely on account of the greater safety to human life. But where danger is not to be feared, with low pressure, I do not think it makes much difference whether the machine is insulated or not. It is certainly more convenient to have it un-insulated, and in that case the trouble or difficulty will be at the dynamo and will not spread to other places. Therefore gentlemen, I hope very much that we will take some sort of action which, while expressing our commendation and approval of the beautiful work which has been done by this committee, will not nevertheless commit us in such a manner as to compel us, either tacitly or in any other way, to approve the rules and compel us to stick to them to the disparagement of other rules that may have a greater priority of action and greater force upon us. In a municipality like New York for instance, especially after it becomes Greater New York, it may become a question as to which of the sets of rules shall have priority over the other. I myself believe that these matters should be entirely controlled by the municipality, and that all other rules should be subservient to municipal rules. It is certainly very desirable that there should be only one set of rules, and as the municipal government assumes to dictate and prescribe rules in relation to the details of buildings generally, and all details which affect public life and public safety, it seems to me that it can also be prepared and competent, or ought to be, and that it is within its legitimate province, to institute rules and prescribe regulations which apply to safety in electrical matters as well as in others. That being my view of the matter, I would certainly dislike to be placed in a position where I must disobey one in order to obey the other. I want to be placed in a position where I can obey the two.

With regard to the rules which are not exactly apposite, or which appear to be somewhat absurd or which include regulations that are not entirely adequate, I may state that those things to a great extent cure themselves. Let a rule be issued which is incompetent or which is not consistent, and it does not take long to discover flaws in it; and the "breach" soon becomes more

honored than the "observance," because the observance becomes so ridiculous and so absurd that it is no longer insisted upon. Consequently I do not look for very much trouble on the score of rules which are not perfect. No one can expect perfect rules. All that I would ask is that in regard to those rules which are not consistent with other rules, (where one is placed in the position of having to defer to various authorities), that there should be no binding action whatever compelling one to obey one set in preference to any other set.

MR. HAMMER:—Mr. Chairman.—Referring to Mr. Mailloux's remarks about insulation of the machine, I would like to call attention to the two sections in the two codes so that you will note how closely they arrive at the same conclusion. The National Electrical Code says:

"Must be insulated on floors or base frames, which must be "kept filled to prevent absorption of moisture, and also kept clean "and dry. Where frame insulation is impracticable, the inspec- "tion department having jurisdiction, may, in writing permit its "omission, in which case the frame must be permanently and ef- "fectively grounded. A high potential machine which, on ac- "count of great weight or for other reasons, can not have its "frame insulated from the ground, should be surrounded with an "insulated platform. This may be made of wood, mounted on "insulating supports and so arranged that a man must always "stand upon it in order to touch any part of the machine."

Now the City Fire Department rules cover that point in this manner.

"Must each have the frame permanently connected to ground "unless surrounded by an approved insulating platform which "will be required for all generators of over 300 volts. Platform "must be of sufficient size to prevent personal contact with gen- "erators except from platform."

It seems to me they are synonymous.

MR. MAILLOUX:—I think they are far from being synonymous. The national rules have a string tied to the permission for doing it while the city rule says distinctly it is only for machines of a certain potential. It brings in the important point I made that the question whether the machine should be grounded or not depends upon the pressure of the machine which is to be installed. I think of the two rules, no one who is familiar with installation work will doubt or dispute that the city rule is much the more logical, consistent and perfect.

MR. C. M. GODDARD:—They say that faint heart never won fair lady. I suppose the fair lady we are after to-night is uniformity of rules. There does not seem to be any difference of opinion on the subject that uniformity of rules is an extremely desirable thing. We never shall get uniformity by discussing the details of the rules in a meeting like this to-night. I have been very closely connected with this matter of rules as far as the under-

writers are concerned, and for the last seven years I have labored as best I could to secure uniformity of rules among the underwriters. I do not believe there are many gentlemen here, except those who have been connected with the National Conference, who realize the difficulty that we had to secure such uniformity among the underwriters. It was worse really than the effort to secure uniformity among all the different interests that are connected with electric installations. There are a great many more independent boards of underwriters than there are national associations which have been working on these rules, and every board of underwriters had its own code of rules. Of course some of them agreed and some of them did not, and we had to get together and the majority had to win the day, the minority had to yield. There are portions of these rules that I do not agree with at all. They are not very essential points, but there are many things in the rules that I would like to see changed, and in our meetings of the delegates we discussed those points and I did my best to get them changed, but if I was outvoted that ended it until the next meeting. There are details in these rules to-day that probably we shall want to change within a year. There are undoubtedly points in the New York City Fire Department rules that are better than these; but you cannot put them into the rules at this meeting. There are a number of bodies that are connected with the getting up of these rules and you are only one of them. The time to make changes is when we have our next general conference. If there is anything wrong with these rules, it is sure to come out and we are sure to find it out and it is sure to be recognized and they will be changed. I believe that the AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS to-night has an extremely important,—I was going to say duty, I will call it function, to perform. I would rather see these rules approved by this INSTITUTE than by any of the other bodies represented in the Conference, and I do not mean with any string to the approval either. I want to see Dr. Kennelly's motion go through. I want the AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS to take a stand one way or the other, and either say that they will or that they will not approve the rules. I do not want them to say that they approve of uniformity. Of course we all approve of uniformity. We will never get uniformity unless we have something to start with. You have got a set of rules here which represent the best efforts of delegates who were supposed to be competent to represent the various national bodies which were collected together in the National Conference on Standard Rules. I have some personal knowledge of the amount of labor that these gentlemen put into this work. The rules were submitted and re-submitted, they were studied over and worked over. The wording of them has been worked over and studied over and they have done the best they could. They believe they present something to you to-night that is better than anything that has been pre-

sented to you before. I think these gentlemen here present believe that. They do not believe it is perfect, they do not say it is perfect, but they do believe it is a step in the right direction and that we have got to take that step before we will ever advance a second step, and I hope that the INSTITUTE to-night will take these rules as they are and not go into the details unless they find glaring errors and I do not believe they can find those. I do not believe that there are any glaring errors in these rules; if there were they would certainly have been discovered by some of the representatives who have been at work on them, they would have been discovered when they were presented to the National Electric Light Association. I am sure that we will get nearer to uniformity by adopting the rules which have come from the representatives of these nine national associations connected with electrical work, than we can by accepting any other one set of rules whether it be that of the New York City Fire Department, or the Phœnix Fire Office of England, or whatever they are. I believe that your delegate to the Conference presents to you here to-night a set of rules which is in advance of any other as a whole, and I believe that the gentlemen here present, if they would study these rules and were as familiar with them as I am, and I think I can say advisedly that I do not believe there is anybody that is more familiar with them; I have read the proof of these rules at least ten times during their printing, besides having seven years experience on the previous rules, working on them as Secretary of the Underwriters Association—if they were as familiar with these rules as they might be, they would find that these differences which they claim exist, could be explained away in just the same way that Mr. Hammer has explained the difference between the New York City rules and the National Code in regard to the grounding of generator frames. The Inspection Department having jurisdiction—which is it? What is it? If it is in New York City it may be the Fire Department of New York City, it does not say the Underwriters' inspection department, it says "the inspection department having *jurisdiction*." The National Code gives permission to the inspection department having jurisdiction to allow the omission of frame insulation if you find it impracticable. I think that any man would feel that it was impracticable to disobey a city ordinance. The New York City Fire Department rules say you *must* ground your generator, and the National Code says you *may*—there are reasons from the underwriters' standpoint why if a generator can be insulated from the ground we prefer it, but we realize perfectly the absolute impossibility of the direct-connected machines, the heavy machines not being grounded. It would be worse than if they were grounded, and all we say is in such cases, ground them, and ground them THOROUGHLY. I do not believe you will find so many differences in the rules as you may think on the first reading, and I do hope

that whatever the INSTITUTE does to-night, the members will come out fairly and frankly and say either yes or no.

DR. CARY T. HUTCHINSON:—I think the last speaker ignores the entire difference between the position of the INSTITUTE and that of the underwriters. It is the function of the underwriters to secure the greatest possible safety in all work, so as to diminish as far as possible the fire risks and the consequent losses; that is, the interest of the body is chiefly one of dollars and cents. The INSTITUTE, however, should take a broader position, and should concern itself with the engineering features, and should not endorse any plan which involves bad engineering, even though it may seem to increase the safety of the work.

I agree with the previous speaker in saying that these rules should receive the approval of the INSTITUTE, yet I think this approval should be qualified by some form of recommendation, leading to the modification of certain rules which I think involves unwise limitations on the engineering points, without any corresponding increase in the security of the work. To illustrate, rule 12, section *n*, provides, "For the diminution of electrolytic corrosion of underground metal work, ground return wires must be so arranged that the difference of potential between the grounded dynamo terminal and any point on the return circuit will not exceed 25 volts."

As this rule stands, no engineer will be permitted to lay out a trolley system involving a maximum loss of more than 5% in the ground return. It seems to me obvious that this is an unwise limitation, and is entirely too sweeping in its scope.

Rule 39, Section *a*, reads, "Secondary wires must be installed "under rules for high potential systems when their immediate pri- "mary wires carry a current at a potential of over 3000 volts." This rule refers to what are classed as extra high potential systems, that is, over 3000 volts in a primary. Under this rule when direct transformation is made from, say, 3500 volts to anything below 300 volts, the secondary wires must be run on porcelain insulators, separated at least four inches and in plain sight. This practically prohibits the use of such secondary wires in any building.

The only alternative is to make a double change from the 3500 volts, or whatever it may be, to the secondary; that is, to install two sets of transformers. This would involve a very considerable increase in cost, would sometimes require space which is not available, and would greatly increase the complication of the system.

The explanation following this rule indicates that it was framed to apply chiefly to danger from lightning striking the high pressure overhead wires. It does not seem that underground circuits were considered at all, yet it is plain, the rule would apply to high pressure underground feeders run in conduits. The rule also implies that the insulation of the transformers is the weakest part

of the system ; whereas at the present day, I think that most engineers would agree with me in saying that the insulation of the transformers is the strongest part of the system.

The engineering plan excluded under this rule, is now in use in almost all of the high pressure plants in the country. For instance at Sacramento, Portland, Fresno, Pelzer, Columbia, and at other places that I do not now recall. Should this rule be adopted, all such work would be prohibited.

I have talked with several members of the Conference regarding this rule, and can find no one who remembers any discussion on it. It seems to have escaped the notice of those present.

These two rules illustrate my position in saying that the INSTITUTE should not endorse bad engineering. I have no doubt that there are other rules of similar character. I think, therefore, that Dr. Kennelly's motion should be amended, so as to provide for the re-consideration of such rules as these, while endorsing the National Electrical Code as a whole.

THE CHAIRMAN :—I see we have with us this evening Mr. A. H. Henderson, Chief Inspector of the New York Fire Department. May we hope to hear from Mr. Henderson in furtherance of the discussion?

MR. ALEX. HENDERSON :—I am not in a position to discuss these rules here to-night, gentlemen. I did not expect to be called on to take any active part in the discussion this evening. I came simply as a guest of the INSTITUTE, and for that reason I may not be able to go very thoroughly into detail. There is apparently an impression that there is a vast difference between the rules recently published by the Fire Department, and the rules published by the National Board—the National Electrical Code which we are now discussing. As I understand the matter, I do not see that there is any great difference between the two sets of rules. A great deal of care was taken in drawing up the municipal rules to follow the principles of the National Electrical Code and to so express those principles as to make feasible rules and to make them apply to the work that is being done in New York City, realizing that no set of rules that was national could be applied locally for all classes of work. We have work going on in New York City that requires different expressions and different interpretations of rules, and we have taken the old national code and endeavored to interpret it and amend it to suit the requirements of to-day in New York City only, without any reference whatever to national work, or work in other sections of the country. I do not think that the municipal authorities have any desire to do anything but follow the principles laid down in the National Electrical Code. If there was any evidence of any such desire I should certainty be one of the first to combat it, because I think that the National Electrical Code that was first published in 1892 is one of the grandest pieces of work that was ever put into print so far as electrical installation is concerned. I think

that national code covers the entire ground in a wide, broad form, but it certainly can be modified and can be amended to suit local conditions. I do not think that the framers of the code intended, in fact I am positive that they did not intend the code as printed to-day to cover the requirements of every city in the country. There are various statements that you find in it, that certain rules must be left to the decision of the local inspection board or local boards or bureaus having jurisdiction.

MR. HAMMER:—I would like to add a word to what Mr. Henderson has said. A similar condition of affairs existed in the city of Boston. Captain Brophy, who was the expert of the Commissioner of Wires there, brought up before the Code Committee of the National Conference certain points which he felt their local conditions necessitated taking cognizance of, and there was quite a lively discussion for some time upon those points which Captain Brophy brought up. Mr. Goddard was there at that meeting and he will appreciate it. And finally Captain Brophy realized that the question of recognizing one single standard code was of such tremendous importance that these local conditions need not affect the situation at all, and his association was prepared then to recognize the National Electrical Code and the suggestions governing certain local points there were put in as an appendix to cover points which, as Mr. Henderson said, are purely local conditions which they have to deal with; and it seems to me that should be done here, and I am very glad to hear Mr. Henderson express himself so strongly in favor of the recognition of the National Electrical Code, because I think that the Fire Department will also recognize the National Electrical Code and that we will have but the one single code here in New York as well as throughout the country. It is only a short time ago that we had four or five of them here. The Edison Illuminating Company had their code, and they had their own inspection. Mr. Fremont Wilson who represented an independent set of insurance interests adopted the National Electric Light Association Code and used that. The New York Board here practically adopted the rules of the National Board of Fire Underwriters. But they introduced modifications, making quite a different code in certain respects, and then the City Fire Department came in as a new element with its set of rules, so that there were four or five different sets. Now it is self-evident that that sort of thing introduces immense complications, causes immense loss of time and money, and much inconvenience and annoyance. Everyone here must recognize that this code is not absolutely perfect, but we must stick to the main point which is the recognition of something that will represent uniformity and be the standard code; and I think that Mr. Goddard and the insurance men here will support me in stating that anyone, whether he is an electrical man or an insurance man, or represents any allied industry, who desires to bring his recommendation or criticisms, before those

who will hereafter control the future editions of the National Code, will receive respectful attention, and if I am not mistaken Mr. Goddard said a little while ago "they are bound to receive recognition." I do not think there is any doubt of that. I am very glad this discussion has taken place, because the matter was taken up at our meeting at Greenacre, Maine, and as there was a comparatively small attendance there at the time, Dr. Crocker and myself and others objected to its being discussed at that meeting and requested that the matter be deferred to a special meeting here in New York City, in order that no one might feel that there was an attempt to force this thing down anyone's throat, but that it should be thoroughly discussed and that the INSTITUTE would act only after an intelligent discussion of the subject.

MR. GODDARD:—Mr. Chairman,—I would say one word in reply to what Mr. Hammer has said in relation to the meeting of the Underwriters Association. The Electrical Committee of the Underwriters Association is composed of twelve, I think, but if any of you attended our meetings you would not know there was any committee. We usually have from forty to fifty present at the meetings, and never in the five years that the association has been in existence and the Electrical Committee been meeting have we taken a vote of the *committee*. Every gentleman who is present is given the full privileges of the floor and of voting. It has not been confined to the underwriting interests, as Mr. Henderson of the New York City Fire Department and Mr. Cole of the Boston Wire Department, and Mr. Stern of Denver, and Haskins from Chicago, have been present at those meetings and taken part in the discussion and voted just the same as though they were members of the committee, and we should be glad to see every member of the INSTITUTE at our meetings, and if you will all come we will manage to find a room big enough to hold you. I do not suppose you all will come. I wish more would come. It is certain that for our December meeting, invitations will be sent in some way to all of the societies which have been represented in the National Conference to be present at the meeting of the committee and to take part in the discussion and in the voting. They will undoubtedly be accorded the full privileges of the committee, and that is the time to make changes in the rules. You cannot do it here. That is the time to bring up the different points in the rules. It is usually done by taking the rules up section by section. We start at the beginning, and we read the first section and ask if there are any suggestions or improvements to be made and go right through the rules one after another in that way, and we have done that year after year for the last five years, and it was the result of these amendments or changes being hitched onto the different rules that made the re-codification of the rules necessary, and that alone has been worth all the work that has been put into the whole conference. Uniformity is worth all the work that we could *ever* put into it.

But the re-codification is worth a great deal. It has brought the rules up to date so that they are intelligible and up to the present practice in electric installations. But every gentleman here may rest assured that he will be welcome at our next December meeting. We hope not to make many changes then in rules that have been issued such a short time, but any important changes that are called for, of course will be made, and the gentlemen will be welcome to discuss the rules and to vote on the changes, and there are enough members of the INSTITUTE to outvote the twelve members of the Electrical Committee of the Underwriters I am sure.

MR. S. DANA GREENE:—It seems to me that Dr. Hutchinson has indicated the proper course for the INSTITUTE to take with reference to these rules. As he says I do not think anyone will dispute with the other gentleman who has spoken as to the tremendous advantage in having one uniform set of national rules recognized by the various underwriters' associations as well as by engineers and manufacturers. But I do think that the INSTITUTE should have a proper regard for itself with respect to technical points, and that some action should be taken by it to study the rules from the engineering standpoint to see whether they have any recommendations to make for changes. I quite agree with Mr. Goddard that it is impossible to take rules which are as extensive as these, and which have taken so long to prepare as these—to take them in one night or a couple of days and be able to discuss them intelligently. But I think that the point raised by Dr. Hutchinson with reference to high potential circuits is very well taken, and that neither the engineer nor the manufacturer interested in the high potential power transmission installations of to-day is worried about the insulation of the transformer. He worries less about that than about any other part of the line, and it seems a very great hardship on a company installing the transmission line, that it should be obliged either to observe all the precautions of high potential wires on the secondary circuits or else introduce a double loss by introducing another set of transformers. I am not clear as to whether the National Conference is to be continued as a body to which suggestions and recommendations can be made for the changing of these rules, and I should be very glad to have some information on that subject. It seems to me, however, that it is the duty of the INSTITUTE, while approving these rules as they stand, so that they may be passed upon officially by the INSTITUTE, to appoint a committee of competent engineers to study these rules carefully so that they can suggest any modification which from the engineering standpoint, should be in the opinion of the INSTITUTE adopted, and if the National Conference is to be a continuing body to which suggestions of that kind can be made, I should like to make a motion, if it is in order, that a committee of that kind be appointed to study the rules and to make such recommendations

at a later meeting as they see fit. I move that as an amendment, that the rules be approved, and that a committee be appointed simultaneously.

MR. HAMMER :—I suppose it is necessary in this connection to answer Mr. Greene's question about the Conference and also to explain the first pages in the special edition of the code, and the fact that it is printed as a special edition. When the National Conference met in this room it held a session of two days and then adjourned, leaving the matter of the preparation of the code in its final shape in the hands of a code committee of seven, with the President, ex-officio, a member of that committee, and they were to report back to the Conference, and a motion was made that the date of the calling together of the Conference should be left to the discretion of the President. The Code Committee represented the principal associations that are represented in the National Conference. After they had prepared the code and it had met with their unanimous approval, the question came as to the advisability of calling the Conference together as a body. If you will look over the list of names that are given there of those who attended the previous meetings of the Conference, you will see that they came from all over the United States. To have called those gentlemen together again would have necessitated a good deal of inconvenience and time merely to receive the report of the Code Committee and practically endorse their findings, which undoubtedly would have been done. After consulting the various gentlemen who attended the meeting of the Conference it was decided that it would be unnecessary and inadvisable to call the Conference together as a body and the code was then published by the National Board of Fire Underwriters and through its courtesy the facilities of its printer were extended to the National Conference on Standard Electrical Rules and this special edition was printed. In order that those who took part in the Conference and particularly those who contributed financially to assist its work, should know what was done with the money that was appropriated, and in order to bring to a satisfactory conclusion the work of the Conference, the special edition of the code, also includes the reports of the officers and Code Committee together with a list of those who took part in the Conference, and it has been understood among the members of the Code Committee and others who have discussed the subject that it was inadvisable to call the Conference together at any time in the immediate future; we felt matters could be safely left in the hands of the National Board of Fire Underwriters on condition that they would do as they said that they positively would do, throw their meetings open to anyone who has any interest in criticising and discussing and improving the National Code, and that at any time in the future, whether it be near or far, if the occasion should arise when it would seem to be advisable to call together the National Conference again, that these various associ-

ations would be again called together to take further action. Personally, as the presiding officer of the National Conference, I do not believe that that will be necessary, and it seems to me that matters should be left to stand as it has seemed best in the judgment of the gentlemen identified with the Conference to allow them to stand, and therefore I do not think that the members of the Conference expect to be called together or will be called together in the immediate future, and if this proposed committee is appointed, which I think is an admirable suggestion of Mr. Greene's,—their recommendations should be made to the National Board of Fire Underwriters.

THE CHAIRMAN:—Before having any further discussion on Mr. Greene's amendment I would like to ask if Mr. Greene's motion has been seconded.

MR. HAMMER:—I would like to second that motion, in-so-far as it relates to the appointment of the committee, if he would make that as a separate motion.

THE CHAIRMAN:—As I understand it, Mr. Greene offers an amendment to the original motion, which has been seconded by Mr. Hammer, that the code of rules as presented, be received and adopted by the INSTITUTE and that a committee be appointed from the INSTITUTE to receive suggestions as to desired modifications of the rules, that committee to report to the National Conference or the National Board of Fire Underwriters at their next meeting.

MR. GREENE:—You have not got my motion quite right, Mr. Chairman if you will excuse me. My suggestion was that this committee should be a committee of the INSTITUTE to report to the INSTITUTE as to whether it, the INSTITUTE, should recommend any changes in these rules: if so, that the changes should be made. In making that motion I asked the question which Mr. Hammer has now answered, whether the National Conference was a continuing body, and it seems to me that that was an important part of the proceedings here to-night. If the rules which have been formulated by the National Conference consisting of nine associations, of which the National Board of Fire Underwriters is one, are to be adopted, it seems to me that that organization should be continued, to consider any possible modifications, because it hardly seems proper that the National Board of Fire Underwriters, however good their intentions may be, and however competent they may be to revise these rules, should have sole say with reference to their revision, when they have been adopted and passed upon by eight other national organizations, as well as the Underwriters' Association. It does seem to me therefore that the National Conference should be kept intact as a body, and that it should be called together periodically, or whenever occasion requires, by the President of the Conference; and I move an amendment to Dr. Kennelly's motion, that the rules be approved by the INSTITUTE as a whole, and that a com-

mittee be appointed by the Council to report to the INSTITUTE at a future meeting any revisions which in their judgment are desirable, and which should be recommended to the body originating and formulating the rules.

MR. MAILLOUX:—I would like to move an amendment to Mr. Greene's motion by inserting after the word "approved;" the following sentence: "In the sense suggested in Dr. Crocker's report."

MR. GREENE:—I accept Mr. Mailloux's amendment, and I would like to say with Dr. Crocker that all that was necessary is that the INSTITUTE should approve the code as representing uniformity and co-operative action. I think that is what Mr. Mailloux had in mind.

MR. SACHS:—Mr. Chairman,—The main function of a set of rules is to set down certain principles and not to dictate the style, quality or economy of the construction adopted. It is utterly impossible to codify all the various views of those interested, in regard to each specific class and style of construction. Each particular type of construction or installation work may be governed by certain essential considerations. This code for instance has been evolved by representative men who are thoroughly familiar with the needs of the day. One of our own most prominent members, in fact our President, has represented this INSTITUTE, and I think that he has been most thoroughly competent in the discharge of his duties. Notwithstanding this fact, when it comes to the question whether these rules agree with all the other national rules, we will find that they certainly do not. While perhaps certain lines are followed, yet there are details which may modify the basic idea in the wrong direction. The desired code must be safe but not essentially economical, or in keeping within any specific construction ideas. As Mr. Goddard has said, these rules are not infallible. They contain elements that he himself does not in fact think are correct. But they give us to a great extent a certain basis of operation which can be handled and moulded afterwards to suit general conditions as they come up. A uniform code throughout the country can only be possible, if every interested body adopts the same basic law which may be modified to meet specific cases, but should not be changed in any one particular case. It appeared to me that some of these possible modifications might be discussed here, but probably this work can best be done by a committee as suggested.

DR. HUTCHINSON:—Mr. Greene's amendment implies the continuing existence of this National Conference, since it says: "That the Committee shall report to the body making the rules." We have just been told that the Conference is not a continuing body, and therefore, it seems that there is no body to which this committee could report.

MR. HAMMER:—I do not think the gentleman has been told that. If within a week, the gentlemen who took part in the

National Conference decide that a meeting should be called, as I am still in the Chair, I should feel it incumbent upon me to call that meeting at once, and if a report of that kind is sent to the National Conference, it would certainly come before myself as President or before Mr. Woodbury as Secretary and be submitted to those gentlemen who are associated with the National Conference, and it will then probably be sent to the National Board of Fire Underwriters—but there would be no difficulty about that, nor should there be in finding out where it could be sent.

THE CHAIRMAN :—I understand then that that National Conference or the Code Committee of it is still in existence?

MR. HAMMER :—The National Conference on Standard Electrical Rules has never been dissolved. It has as yet not been called together for that purpose.

THE CHAIRMAN :—I think that is a sufficient answer to Dr. Hutchinson.

DR. HUTCHINSON :—It seems to me that the re-assembling of the Conference is purely a matter of grace, and not a matter of right. Mr. Greene's amendment would imply the approval of the rules, coupled with the possible opportunity of modifying them when the Chairman of the Conference sees fit to call that body together again. There is no assurance that the Conference will meet again.

THE CHAIRMAN :—I understand Mr. Hammer as President of the Conference to say that he would be prepared to call a meeting at any time.

MR. HAMMER :—At any time ; within a week, or a month or a year.

DR. HUTCHINSON:—Understand me, I do not oppose the approval of these rules. I intend to vote for their approval, but I wish them to be approved in such a way that the INSTITUTE will have left to it a clear and definite plan, by means of which certain obnoxious rules can be modified. I think the appointment of this committee is a cumbersome way to accomplish this object. The matter should be left in the hands of the Council. I, therefore, think Mr. Greene's amendment inadvisable.

DR. KENNELLY :—I think that I voice the general sentiment in saying that nearly all of us are in favor of adopting the report ; but some of us are in doubt as to the consequences of such action. No set of rules can be perfect, and even if the members of the INSTITUTE were appointed to frame such a code of rules, there would no doubt be dissentient opinions. The approval of this code of rules by the INSTITUTE as a body does not of course mean that each individual rule receives the unqualified endorsement of the INSTITUTE. Besides, changes in rules must come in a growing science and art, such as ours, and we may reasonably hope that such changes will steadily eliminate from the rules all requirements which may prove to be imperfect engineering. I hope,

therefore, that the rules, as they stand, may meet with the hearty approval of the members at the present time.

THE CHAIRMAN:—We will now proceed to put the original motion of Dr. Kennelly's as amended by Mr. Greene and re-amended in part by Mr. Mailloux. Will you kindly read that motion.

The stenographer read the amended motion as follows:

"That the report which is here presented be adopted by the INSTITUTE, be spread upon the minutes, and that the National Electrical Code, as it is here presented to us in pamphlet form, be printed in the TRANSACTIONS; that the rules be approved by the INSTITUTE as a whole, in the sense suggested in Dr. Crocker's report, and that a Committee be appointed by the Council to report to the INSTITUTE at a future meeting any revisions which in their judgment are desirable and which should be recommended to the body originating and formulating the rules."

The amended motion as read was then adopted.

MR. GODDARD:—I would like to say just one word in correction of what Mr. Hammer has said in speaking of the National Board of Fire Underwriters. He should have spoken of the Underwriters' National Electric Association, as it is their Electrical Committee that has charge of the rules for the National Board, and it might perhaps interest the members here to note that three members, Messrs. Merrill, Fitz Gerald and French, of the Code Committee of the National Conference, are members also of our Electrical Committee, so that your Code Committee always has a pretty good representation there, and if we attempt to do anything that is very, very bad, I think Mr. Hammer, as President of the Conference, would hear of it.

MR. HAMMER:—Mr. Chairman, before we adjourn, I would just like to say one word—I intended to say it before, and that is to congratulate the INSTITUTE on its appointment of Dr. Crocker as Chairman of the Code Committee, as no one whether connected with the National Conference or outside of it can appreciate his disinterested work and his energy and ability more than I, and in going to the various meetings, held in New York, Boston and elsewhere, and holding conferences with him on many occasions, I have been in a position to know that Dr. Crocker has given an immense amount of his time, and sacrificed his personal interests, and even his own health to the worries and anxieties of this code, and it has been a very difficult piece of work, and possibly you gentlemen who see it printed in this shape do not realize all this. A great deal of that burden has fallen on the Chairman of the Code Committee, and I feel that it is no more than just, to say this at this time in approval and endorsement of the earnest and disinterested efforts of Dr. Crocker in this direction.

THE CHAIRMAN:—Gentlemen, after this rather lengthy discussion I think we all of us heartily appreciate the efforts that have been made by the INSTITUTE's representative, and I should be very glad to entertain a motion that the INSTITUTE pass a vote of thanks to Dr. Crocker for his work in this direction.

[Mr. Mailloux rose.]

MR. GODDARD:—I am going to get ahead of Mr. Mailloux on that, because I stand here in a sort of dual capacity as the representative of the underwriters as well as a member of this INSTITUTE, and as their representative I feel that I would like to move that the INSTITUTE extend a vote of thanks to your delegate. We would like to do it ourselves. We have found him always ready to meet with us and talk with us, a gentleman and a scholar in every respect, and I move you, sir, that the INSTITUTE do extend to Dr. Crocker, the delegate to the National Conference from this INSTITUTE, a hearty vote of thanks for the labors which he has bestowed on that work in preparing this "National Electrical Code."

MR. MAILLOUX:—Mr. Chairman, I would like the privilege of seconding that motion, because I want to have Dr. Crocker feel that I appreciate to the full limit this work, even though I claim the privilege of having opinions of my own which may differ somewhat from his. It is no compliment to say of Dr. Crocker that he has done this particular thing well, because he does well everything that he does,—as well as he can, earnestly and truly. He is known to all of us as a hard worker and a man who is terribly in earnest—perhaps too much so—about everything he does, a man without fear or favor, and who tries to do his "dead level" best, every time. In this case the gratifying reports which we hear from the people that have been associated with him in this work are merely a corroboration of the observations we have made ourselves in relation to his work, and I want to testify to my deep sense of appreciation of the earnestness and thoroughness he has manifested in this particular work. I can understand the difficulties Dr. Crocker has had to contend with in working over these rules. I have been troubled by indigestion and loss of sleep many times from underwriters' rules and I have to do with them possibly as much as any member of the INSTITUTE. My work is of a character that brings me into intimate contact with them. Consequently, I can appreciate any effort that is made to improve them and any good work that is done in behalf of better rules. So that I think I have certainly had good opportunities to see the good work he has done, and knowing the personal character of Dr. Crocker so well, his earnestness and devotion and zeal in anything that he undertakes, I feel sure that no comment could be too eulogistic or too full of praise for the work he has done at this time. I may not, at present, be disposed to accept all his conclusions, but I certainly commend his efforts, admire his application, and applaud his ability and energy.

THE CHAIRMAN:—Gentlemen, you have heard the motion, which it gives me particular pleasure to put, that the thanks of the INSTITUTE be extended to Dr. Crocker for his able and excellent work as representing the AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS on the Code Committee. Those in favor please say aye.

The motion was carried unanimously.

THE CHAIRMAN:—Before asking for a motion to adjourn, I hope Dr. Crocker will take the Chair and put that motion himself and favor us with any remarks, as we have not heard from him.

DR. CROCKER:—(In the Chair). Gentlemen, I am deeply grateful to you for your very hearty expression of thanks to me. I must confess, however; that it is somewhat tinged by a feeling that the action taken by the INSTITUTE is not what I should have liked to see done. I am sorry to have to make that statement, but I feel called upon to do so, because in my opinion the matter deserved better treatment. While in my own report I said that no binding adoption was called for, I think a much more clean-cut approval could have been made. Even now I do not know whether the Code is to be printed in the TRANSACTIONS.

MR. HAMMER:—Certainly.

THE PRESIDENT:—If not, I should certainly suggest a motion that it should be, because the discussion will appear in the TRANSACTIONS and I think the Code will stand comparison with the discussion.

[Adjourned].

NATIONAL CONFERENCE ON STANDARD ELECTRICAL RULES.
12 WEST 31ST STREET.

New York, Dec. 10th, 1897.

RALPH W. POPE, ESQ., SEC'Y. AM. INST. OF ELEC. ENGINEERS,
12 W. 31st St., New York.

DEAR SIR:—In printing the report of the meeting at which the "National Electrical Code" was discussed and approved by the Institute, I trust that cognizance will be taken of the fact that in addition to the six Associations whose names were given as having already approved of the Code; that approval was subsequently given by the three (3) remaining organizations, *i. e.*, the American Institute of Architects, the American Street Railway Association, and the American Society of Mechanical Engineers.

Respectfully submitted,
WILLIAM J. HAMMER,
President of National Conference
on Standard Electrical Rules.

Discussion in Chicago.

The meeting of the Western members of the American Institute of Electrical Engineers was called to order in the Lecture Room of the Armour Institute of Technology, Chicago, Ill., on September 29th, 1897. at 8 o'clock, by Vice-President Stine. The discussion was opened with Mr. A. S. Hibbard in the Chair.

The Chairman, (Mr. Hibbard):—Gentlemen, we have for the consideration of our meeting to-night rather an important matter for us as members, and for all of us who are interested in wiring, or the operating and installing of wires. We are fortunate in finding in these rules which have been furnished us, the result of a number of meetings, which have been held during the past year, and compiled by the delegates from our own association, from the American Institute of Architects, the American Society of Mechanical Engineers, the American Street Railway Association, and representatives of the insurance and municipal interests. There are a great many rules given, but, I think in reading them we will find that they are the result of former rules, modifications in many instances, and showing improvements in many others. It will not be possible, of course, in the limited time of this discussion, to take them up, one by one, or page by page. In a general way, however, and in the interests of the various members, it will be possible to consider them.

We are fortunate in having at our meeting to-night one of the members of the body by which these rules were formulated,—Mr. W. H. Merrill, of the Chicago Underwriter's Association. I think, after we have heard from some of our members in a general way on the subject, it will give us all a great deal of pleasure to hear from him. It is suggested that the discussion of the subject in general and as much in detail as our various members may wish, will be begun by members of the Institute. It is interesting to know that the members of the Institute in New York are taking up the same matter to-night, and there is no reason why the general work we do should not follow the line of what takes place there this evening. I would like Mr. Pierce to begin the discussion.

Mr. R. H. Pierce:—I did not expect to be called upon to start up the discussion, for I have not taken any time to make special preparation for it, and had no warning. I am a little ashamed to acknowledge that I have not followed up the recent discussions and papers that have been written on this subject. There has been so much written on this question, and everyone has had so much to say about it, that I really got tired of trying to keep posted on all the views, and just whose ideas are embodied in the recent changes, I am sure I don't know.

I think I am hardly the one to start the discussion to-night, for the reason that the only way to get what is really a good discussion

—that is, the *pros* and *cons* of a subject of this kind, is to start up a strong spirit of antagonism and oppose the rules. That would awaken the champions of the cause, and would bring out a discussion. I have in the past put myself in such a position that I could not consistently play the role of an opposer. I hope there is some one here who has some interest, from a commercial point of view,—some one who will take exception to parts of these rules, because we have a good champion in Mr. Merrill to bring out all there is to say on the *other* side. The only thing that I have heard againt the rules lately, was said by a manufacturer of wire. He said he sold but very little of his highest grade of wire, because the rules specify a long list of wires, and a customer who wants to wire a building is told that he must use one of the wires designated by the underwriters. Instead of stating a certain make, the customer simply says that it must be a wire specified by the underwriters. This gentleman told me that as a result, the cheaper grades of wire have become still cheaper; that they make them as cheap as they can be made and put on the market, and on account of this demand for an inferior product, he sells more inferior than high grade wire. The moral to all this is that we should not look upon the electrical code as being a complete *specification*. I think that we are all very glad, those of us who have occasion to draw up specifications, to have something which governs as well as this code does, all branches of the work in a general way. It is only a few years ago, when, in writing up specifications, nineteen-twentieths of the specifications consisted in a description of methods and devices necessary to secure safety, and it was simply covering in a poor way and in many words what is covered in a very good way, and in a few words in this code. Now, instead of writing fifteen or twenty pages of details, we simply say: "Such and such things must be in accordance with the latest edition of the national code."

But the architect and the man who wants to put in a plant or installation, without any specifications, simply states the capacity of his plant and machinery, how many lights he wants, and then states that the work must be done according to the national code, and thinks he has done the whole thing. I think if I were to make any criticism at all, it would be on the way the code is *used*; it is used often for something for which it was not designed;—that is, it was not intended to take the place of specifications. The engineer and the architect are supposed to take care of them. If I understand the object of the code it is to secure safety to those who handle and use the electrical energy, and there is little that can be added in the specifications now in the way of securing safety excepting in the selection of such materials and methods as are particularly adapted to the special conditions. If engineering work could be classified so that we would have a certain number of cases and designate them, so we

could find Case No. 1 and use such and such material, Case No. 2, use so and so, it would be different. But it has been my experience that every piece of work, where you try to get the best results for the least money, is, to a certain extent, a *special* case. Whereas the code, of course, treats every kind of a case in a general way, of course it does not and cannot particularize in these special cases. This may be a small point to dwell upon, but I have in the past spoken so enthusiastically of the code and acted as its champion among central station men and others whom its requirements have hit in the pocket, that I have not left very much ground on which to stand to criticise it. I hope that there may be some one here who has given the matter more thought than I have, and who will start a discussion which will bring out the views of both the friends and the opponents of the code.

THE CHAIRMAN:—I think that the remarks of Mr. Pierce have brought out a tangible point or feature which underlies all the rules, and as he has brought up one point of criticism, possibly Mr. Merrill will help us out, as these points are brought up. If he can answer that particular point now and some other point later on, as it shall be brought up, it will save his time, and enable us to take it up while it is fresh in our minds.

MR. W. H. MERRILL:—I know that Mr. Pierce, as the author of a work on the National Electrical Code, and also as the author of a paper on this topic read before the Northwestern Electrical Association, can hardly be expected to start out and criticise the rules. He overlooks the fact, however, that the list of wires is not published in this book. The rules, as he states, were formulated solely along the lines of promoting safety, and were not intended to cover specifications that an engineer should be called on to supply. The rules governing safety do not take into consideration whether a man puts in a machine that is twice too large for his plant, or not. Every installation needs an engineer in addition to an inspection under this code. The engineer may do the inspector's work, but the inspector cannot do the engineer's

MR. A. V. ABBOTT:—The tendency of civilization is, it seems to me in every direction towards specialization. In savagery each man supplies his own wants and furnishes himself by his own labor, with all that he needs. With the progress of civilization, however, the time soon arrives when it is impossible for each individual to supply his increased diversity of wants, and humanity splits into divisions, each one selecting some different line, or avocation, and becoming therein an expert, while succeeding generations elevate the particular branch to a higher point than the majority of his competitors. Thus, as a result we presently learn to depend largely upon the labors and efforts of others for the supply of our multitudinous desires. In no direction is this tendency more marked than with engineering. It is barely 20 years ago since civil engineers were the only members

of the profession, whereas now the art has been sub-divided, and electrical engineers, mechanical engineers and sanitary engineers share the honors with the older members. Such a subdivision is particularly necessary in engineering, for during the last few years, the scope of the profession has broadened to such an extent as to make it impracticable for anyone to become even a partial expert along all lines. This is markedly the case in dealing with electricity, for in electrical lines we are handling a form of energy that is comparatively new, one in which experience is exceedingly limited. It is a particularly subtle and elusive form of energy, and while on the one hand these very qualities enable it to be handled and made subservient to the welfare of mankind in ways impracticable with other forms of energy, it is on the other hand correspondingly dangerous and difficult to control, and liable when treated in an ignorant and unskilful manner to do a correspondingly greater amount of injury. However, in this respect electricity is not exceptional, for there is scarcely anything employed in the service of mankind, which, if improperly used or ignorantly treated, is not prone to become a source of danger. This is markedly the case in medicine, with steam, with explosives, and with machinery of all kinds. The fact that electricity has been so recently applied and that its introduction has become so rapidly widespread, makes it particularly necessary that it should be skilfully handled under proper rules and restrictions, and for this reason I think we should be gratefnl at the present time for the care and pains which have been taken in forming a code, giving such rules and instructions as the best present experience indicates advisable in dealing with this form of energy. At best there is so much that is unknown about electrical installations that they are certain to become sources of extreme hazard if they are not introduced in the best and most skilful manner, and it is impossible to expect that the mass, even of artisans, will understand completely a subject that fifteen years ago had but two practical applications. Men in active life find it difficult to keep pace with ordinary events, to say nothing of thoroughly acquainting themselves with the strides which have been taken by electricity. Now the best experts in the country have taken the matter in hand and have here formulated a code so simple and yet comprehensive that ordinary mechanics can, by strictly following the same, build safe electrical installations. The code, perhaps, has still another vocation, for we are aware that in all classes of builders and constructors there is a tendency not only to do ignorant work, but that which is unscrupulous as well. We are acquainted with the existence of builders who take contracts at such prices that it is impossible for them to fulfil them without either loss of money or the evasion of the proper methods of construction, and unless around such unscrupulous constructors a hedge is built so tightly and so carefully as to prevent them from thus unscrupulously introducing defective

work, the public is bound to suffer; but if, from time to time, such a set of rules and regulations as we are now considering be formulated, and if it be adopted with so strong and vigorous public spirit as to render it impracticable for unscrupulous as well as ignorant artisans to evade the same, it will be possible to obtain a quality of work and grade of materials which shall, on the whole, be best suited for the purpose, and will in the long run greatly conduce to public safety and convenience, and by relieving the public mind of the fear of danger from electrical installations, will operate as a most powerful stimulant to the further expansion of electrical industries.

I am, therefore, of the opinion that while perhaps a canvass of the code at present, and, it may be, a revision of the same from time to time in the future, as experience shall indicate modifications to be desirable is advantageous, the important duty lying before each and everyone of us, is to take this code up in our daily practice and by all the weight and influence in our power to see that its spirit and intention are carried out as completely as possible.

MR. S. G. MCMEEN:—Is it expected that at this meeting of the eastern and western members of the INSTITUTE, be the time and season when the stamp of approval will be placed upon the code if at all, or will it be voted upon to-night?

THE CHAIRMAN:—(MR. HIBBARD). It is my understanding, that if the code, as it stands, meets with the approval of the meeting here and in New York to-night, it will be in order to recommend its adoption by the Council of the AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. If it is the sense of the meeting that it is a good thing, such a recommendation will be made to the Council. Our President, Dr. Crocker, who was a delegate to the meetings which resulted in this code and rules, made a report to the INSTITUTE which will be read shortly. He endorses the code and gives his reasons very briefly and well, and he undoubtedly is an attendant at the meeting in New York to-night. In his absence, we have his report, which we will hear after we have had a little more discussion, either on the general or the more specific matters relating to the code. I do not understand that it is expected, on recommendation of a code like this, that we obligate ourselves to never vary from the code, any more than that we never vary from the Golden Rule, and several other things of that kind, but it is intended as showing what we would recommend and desire to bring about in our own work.

Without bringing shop matters into the discussion too much, it would be interesting, I am sure, to hear from some of the railroad people present. We would like to know how a set of rules, such as we have here, appeals to a trolley man as applied to a trolley road, and whether he feels that his plant is improved and benefited by them, and whether they are reasonable and right. I wish also that we might have an expression from a

power man, one representing power plants of some kind. There has been, perhaps, a feeling that the trolley road was essentially a new thing, and while it has been improving tremendously in detail during the past five years, it has been extending so fast many of us have felt that its management frequently either had not the time to look into details and keep off its neighbor's toes, or, perhaps, did not want to, and failed to recognize reasonable rules designed to curb and govern them. Other people, I am sure, feel that such regulation is beneficial. Whether the trolley road representatives feel that way or not they can say better for themselves.

MR. R. E. RICHARDSON:—I do not know as I can say much on that subject, although I have given considerable thought and attention to it in connection with insurance risks, etc. I believe we will all agree that the best thing that has been done in the way of insurance rules in regard to trolley wires, was the making of the rule which absolutely prohibits the carrying of a street railway circuit into buildings, and using this current for motors or lighting, which necessitated a ground in the building. It is to my mind the very best thing in an individual rule that the electrical underwriters fraternity ever made in taking the ground circuits of a high pressure current out of, or preventing them from going into buildings.

There is one thing which crosses my mind not in relation to trolley work or railway work, but a point which it seems to me the code has not exactly reached as yet. I may be speaking from ignorance, however, as I have not carefully read through the last code. This is the question of line appliances in the way of safety devices, sockets, etc., for the present fashionable 220-volt work. I had occasion lately to examine a number of 220-volt lighting plants and found they were using exactly the same cutouts, same sockets, fixtures, etc. throughout that are designed for 110-volt work. While there are now 220-volt switches on the market, I do not think there has been anything done in the way of manufacturing sockets, fuses, etc., especially for this voltage. In one of the plants examined, I asked the engineer what he was using for sockets, cutouts, etc. He replied he was using the same as for 110-volt work, and in answer to my question if he did not have a great deal of trouble, he said: "Oh no; once in a while they burn out." A few moments later, I noticed a switch which was nicely cooked and asked him if that was not one of them. He replied, "yes." Going farther, I found numerous cases of the same sort. It seems to me that the 220-volts for lighting is at present the prevailing fashion, a great many plants of this voltage being put in, and I do not think that the supply manufacturers are prepared for it. For instance, take an ordinary socket which can be bought for one-half or one-third of what ought to be paid for a good article. These sockets are not suitable for a 220-volt break, as with this pressure

an arc has little trouble in being formed in the socket. It is the same way with many of our fuse blocks.

I do not suppose for a moment that this subject has been lost sight of by the underwriters, but perhaps it is something that they have not yet had time to get into the rules. My own experience in examining a number of installations with this pressure is, that there is a great deal of trouble and a great many burnouts in the fixtures and in places where they would not have occurred, I am sure, if the ordinary 110-volt or low voltage current was in use. I will be pleased if Mr. Merrill will advise us as to what has been done in this regard in the way of having the manufacturer supply a line of material especially designed to accomodate 220-volt circuits.

MR. MERRILL:—I agree entirely with Mr. Richardson that the fittings at present on the market, with but very few exceptions, are unsuitable for use at 220 volts; I would go further and say that many of them are unsuitable for use at 110 volts. As far as the code is concerned, however, I think the matter is fully covered. All of the rules relating to switches, cut-outs and similar appliances specify, first, that the manufacturer's name or trade-mark should be stamped on the goods where it can be plainly seen; second, that all of these fittings must operate successfully at 25 per cent. excess voltage and 50 per cent. overload in amperes under the most severe conditions they are liable to meet with in practice. These are the general provisions for all fittings. Besides these, you will find detailed specifications for the construction of many common appliances. Their use at 220 volts, 440 volts, 500 volts, and all voltages, is covered in these specifications. In that respect, this edition of the code is far in advance of the '96 edition.

MR. PIERCE:—I believe that all of us ought to say exactly what we think about this code, especially those of us who are engaged in engineering work, and I believe we would all say that the code fulfils the purpose for which it is intended so well that it does not seem fair to criticise it. But I think, inasmuch as the code is a matter of evolution, that if we have any one with us who considers the code imperfect, or who has anything to suggest as to how it could be improved, we would all gain something by hearing it. I notice a gentleman here who represents a branch of the art which as yet has not been represented in our meeting here to-night, and while I do not wish to intimate that he is not an engineer, at the same time he is interested more especially in the supply business, and the changes in the code may have helped him or may have created some trouble for him, and perhaps he will give us some insight into the matter. The gentleman I refer to is Mr. Burton.

MR. C. G. BURTON:—It has occurred to me in looking over the list of authors who are responsible for the revised rules, or as it is termed, the National Electrical Code, that the electrical

associations, underwriters' associations, architects, and various other people are represented, but there is one man who is obliged to stand the brunt of all these changes, and who I do not find represented here, and he is the much maligned supply man. It is an easy matter to formulate a set of rules and say: "We will allow such and such an article." On the strength of this statement, and practically a guarantee, the supply man, who is on the alert for money-making products, lays in a nice stock in anticipation of a profitable venture, but is soon notified that the use of this particular article is prohibited and to make it still more emphatic, photographs and descriptions of the articles are widely distributed. Now where does the supply man come in?

I was very much taken with the remark made a few moments ago in which our friend advocated the idea of compelling the manufacturer to get out a better quality of apparatus. In '84 I traveled about the country trying to sell electrical apparatus and among other things a very poor grade of socket for which I endeavored to secure 85 cents. At one time I took an order for quite a quantity at 80 cents and the firm very promptly turned me down. I presume it cost them as much as 15 or 20 cents to manufacture. I can now sell a better socket and make a fair profit at 8 cents. Now this idea of compelling the manufacturer to make better apparatus is not correct. You commence at the wrong end of it. What should be done is to compel the consumer to use a better grade of material, and the manufacturer and the supply man would be only too glad to sell him a better class of material. Under present conditions a dealer will put in a large stock of sockets, for instance, which cost him a certain figure. He possibly soon ascertains that his competitors are selling sockets at a much lower price than he can afford. His only recourse is to compel the manufacturer to make a cheaper socket which enables him to meet competition. As long as the consumer will purchase and use a cheap, low grade of material, just so long will the manufacturer and the supply man handle material of that character, but in all this the supply man is the one who is blamed because he sells such poor material, whereas the real reason exists in the fact that the underwriters and others in authority do not compel the consumer to use a better grade.

With reference to the matter of wire, I notice for the first time that the revised national code omits a long list of wires that it formerly contained. I presume that this was due to the efforts of our underwriting friends, and also to the overwhelming sense of injustice that they must have felt in putting their stamp of approval so indiscriminately upon anything and everything that bears resemblance to wire. The house with which I am connected sells a good wire; has been selling it for 8 to 10 years. Our friends, the publishers of newspapers, have been able to declare dividends on the basis of money expended in

advertising and pushing this particular product. We still sell that wire at fair prices and at a fair profit. Under present conditions, however, the customer asks for quotations on wire, which we readily make. If this is unsatisfactory and he wants lower quotations, we quote him on another wire that we can purchase in the open market and which we can sell him at about two-thirds the cost of our regular and standard wire. He inquires if this cheap wire is approved by the underwriters and we can but answer that it certainly is, and we are further willing to guarantee that it does not contain over 60 and 10 per cent. of mud. The fact is that we can make more money selling the cheap wire than we can the high grade of wire which is simply due to formerly indiscriminate endorsement by underwriters' associations. Under these conditions it is but natural that the consumer should use the cheap wire where he has no interest at stake subsequent to its installation, and it is this condition of affairs that has led to a great deal of this cheap quality of construction, against which there seems to be so much objection. It is to the interest of the supply man to be enabled to sell a better quality of material of all kinds. The supply man acts as a go-between. We do not manufacture or originate material; we handle material which has been originated and manufactured by some one else, which we offer to the consumer. We would much prefer to sell a good article at 15 cents than two poor articles at 7½ cents each. When we sell staple and satisfactory goods to a customer we get his good will and the assurance of his future patronage, but if we sell him a poor affair the danger exists that it will influence him against us, so betwixt the disposition of underwriting concerns to call for a high standard, and the disposition of the consumer to purchase a cheap article, the supply man is kept continually in hot water, and is practically blamed for all the poor material. Surely we are a much maligned fraternity.

MR. RICHARDSON:—In answer to the gentleman who has just spoken, I would say that I was once connected with a large electrical supply house and think the facts in the case are these: That the supply man has a disease, but does not go to the right doctor for a cure. He does not want to go back to the manufacturer for redress, but should work in harmony with the underwriters, and just as soon as he, the supply man, will refuse to buy or sell an article, which is not first class, (and he admits it is poor policy to sell an article of inferior quality), he will then have no further trouble with his sockets, etc., no bargain counter referred to, and the customers who have bought his goods will come back to him for more of the same kind instead of being dissatisfied and going elsewhere. It seems to me the supply man has as much opportunity to help out in bringing up the standard of electrical material and appliances as the underwriters themselves.

If the supply man, as above stated, will not buy or sell cheap goods, it naturally follows that the other fellow, the construction man, cannot get and use inferior material. It does not seem to me that the keeping of seven or eight grades of a material, ranging from poor or worthless up to good quality in order to catch all classes of trade, is in harmony with the code or the spirit in which it was written.

As previously stated, I was once connected with a very large supply house and can state from experience that the money made by that house and the reputation they gained was not made or gained by the sale of cheap goods. Where good goods are sold, they are sold to stay sold, and where poor goods are sold, they usually come back, the customer staying away. I can well remember when sockets referred to sold for 85 cents, and it may be that a better socket than these were can now be sold for 7 cents, but I doubt it. A good socket, I do not think it necessary to tell this audience, cannot be built for 7 cents and it is just these little things that tell in an installation. An immense amount of time, energy and money is spent to bring up the standard of a piece of machinery, as, for instance, a dynamo, to get a high field, commutator and armature insulation, and then some paltry little cheap 5 cent device is connected up to the system that destroys the entire insulation of the installation. It does not seem to me that the supply man is such a terribly maligned individual, and if he has an ailment, the cure rests largely with himself.

THE CHAIRMAN:—I would like to bring out the fact, that the rules we are looking over are not solely underwriters' rules. They have been made by the representatives of the national institutes of architects, electrical engineers, mechanical engineers, street railway and electrical lighting people, as well as by the underwriters. I don't think the underwriters even had a majority in the meetings. I think that if the representatives of the architects, railroads and electric lighting associations wanted to, they could have out-voted the underwriters, which they do not seem to have done. I have no doubt if there was an association of the people who make the goods, they would have joined in the same line. We have no set of rules for the supply men or for the manufacturers. It would interest us to hear something on the broad matter of the rules themselves, from the gentleman who was one of the board which made them up. I will ask for some final remarks from Mr. Merrill.

MR. MERRILL:—The printed history of the rules tells the tale from start to finish, and this code is its last chapter. This history you may read in the little books which I have sent here, and I think probably it will prove more interesting to you in the form in which it is there presented than it would recited by me. The code itself is not a fire underwriters' code any more than it is a life underwriters' code. The life insurance people

might be just as much interested in this code as the fire insurance companies. The Chicago Fire Department and other city departments have adopted it. It is of just as much interest to architects, electric lighting men, central station men, supply houses and electrical contractors as it is to us. The remedy for existing evils does not lie wholly with the fire insurance man. He is a pretty charitable sort of person, spending something like $150,000 a year in the vain endeavor to educate the people up to good construction, and it is unreasonable to expect him in all cases to prevent poor construction. The matter is one of general interest, and it should always be one of general education. I would be very glad if it could be taught in the public schools. Some day, perhaps, it will be. It seems to me that an institution of such a national character as yours, and one having such great potency in the matter of the standard it adopts, should consider it within your province to further this work, to give the stamp of your approval to a set of rules which has been very largely compiled by your own delegate, and in this way help along the general cause, in which we are all very much interested, I am sure.

PROF. W. M. STINE:—I have in my hands a report which is being presented in New York this evening by Dr. Crocker. He is a member of this National Conference.

[Prof. Stine read the report, see page 518.]

MR. MERRILL:—The Conference has been invited to co-operate with the Underwriters' National Electrical Association at its meetings, and consider any revision, extension, or amendment to the code. It is not expected that it will be necessary to make any changes in this general wording for, we hope, at least two years to come, but we propose to meet again in December to talk over all the suggestions of improvements which we might receive in the meantime from any source, and if there is nothing to be revised at that time, we propose to let it stand as at present. The future work will be in the hands of these various interests, and in the event of changes of any consequence being made, it will be the duty of your delegates to report to you for further action.

MR. A. V. ABBOTT:—I would like to ask how this code compares with similar documents in England.

MR. MERRILL:—It is altogether different. British practice, of course, differs from American practice; and while I am not very familiar with the construction work going on there, I should judge the code of rules recently adopted by one association in England, compared with this code, could be called crude. That code has been refused by a number of fire offices there, each preferring to retain former methods. They are in the same danger there that we have been in here for several years, not only in their organization as to a code, but, beyond that, each fire office has a code of its own, which makes it very much

more embarrassing than to have a code agreed upon by even all of the insurance companies. It may be that practice in England is carried on so conscientiously that such rigorous handling of rules and their enforcement is not necessary. I can see no other explanation for their being apparently so far behind the times in the way of rule-making.

MR. ABBOTT:—The code of rules that I had reference to has been received within the past month. I noticed that the carrying capacities were somewhat larger than ours.

PROF. STINE:—I would like to read the following resolution:

Whereas, The rules and requirements for the installation of wiring and apparatus for electric light, heat and power, known as the "National Electrical Code," are the result of the united efforts of the various electrical insurance, architectural and allied interests represented in the National Conference on Standard Electrical Rules, composed of delegates from the

American Institute of Architects,
American Institute of Electrical Engineers,
American Society of Mechanical Engineers,
American Street Railway Association,
Factory Mutual Fire Insurance Companies,
National Association of Fire Engineers,
National Board of Fire Underwriters,
National Electric Light Association, and
Underwriters' National Electric Association, and

Whereas, This Code is shown to be the best at present available for use from the fact that it has been adopted by the various municipal and insurance inspection departments of the country, as well as by the National Electric Light Association and the National Board of Fire Underwriters and other bodies, and

Whereas, Representatives of the AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, headed by the present President of the INSTITUTE, were important factors in its compilation;

Therefore be it resolved, That the "National Electrical Code" be and hereby is endorsed for general use as a standard set of specifications governing the safety of electrical equipments, and

Be it further resolved, That this Code be recommended to the Board of Management for adoption as the standard of the AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

Mr. Abbott moved, and the motion was seconded, that the above preamble and resolutions be adopted. The motion was carried, and the above unanimously adopted, whereupon the meeting adjourned.

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RALPH W. POPE, Secretary.

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